[redacted]

APPENDIX A

BIOASTRONAUTICS-DISCOVERER

BOARD REPORT

22 December 1959

CLASSIFICATION OF THIS DOCUMENT
WILL BE DOWN GRADED TO uncl
UPON REMOVAL OF ENCLOSURES.

~~CONFIDENTIAL~~

[redacted]

~~SECRET~~

WDZ-1-7

BIOASTRONAUTICS-DISCOVERER

BOARD REPORT

22 December 1959

Copy #3 of 3

DOWNGRADED AT 12 YEAR INTERVALS: NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

~~SECRET~~

~~CONFIDENTIAL~~

SUBJECT: Report of Proceedings of DISCOVERER-Biomedical Board Convened Under Special Order Number 20 Dated 27 November 1959 as Amended.

TO : Commander
Air Force Ballistic Missile Division
Air Force Unit Post Office
Los Angeles 45, California

I. AUTHORITY AND BOARD ACTION:

On 2 December 1959, a Board appointed under AFBMD Special Orders Number 20, Exhibit A, was convened at 0900 hours in Room 205, Building 4, Hq, Air Force Ballistic Missile Division. The Board met in daily session to hear briefings and testimony from a list of witnesses, Exhibit B.

The following Board members were present on all days:

Colonel Paul E. Worthman	Hq AFBMD	President Voting
Colonel John E. Pickering	Hq SAM	Member Voting
Lt. Colonel James S. Seay	Hq BMC	Member Voting
Major William H. Weaver, Jr.	Hq AFBMD	Member Voting
Dr. Fred Berner	WADC (Representating Hq ARDC)	Member Voting

The following Board member was absent on all days:

Lt. Colonel Raymond E. Zelenka	Hq AFBMD	Member Voting

On 8 December 1959, at 1430 hours, the Board recessed to begin preparation of its findings and report. Verbatim testimony was taken by the Board; when this testimony plus supporting documents are in final form they will be Exhibit O of this report.

~~CONFIDENTIAL~~

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

II. MATTERS INVESTIGATED:

In a directive, Exhibit C, subject, "Investigating Committee", to the Deputy Commander/Space Systems, dated 29 October 1959, the Commander AFBMD outlined matters to be investigated, as follows:

A. Determine the facts regarding specific allegations challenging the technical adequacy and management of the biomedical portion of the DISCOVERER system.

B. Make recommendations regarding the management structure of the present biomedical program and possible future programs.

C. Make specific technical recommendations regarding the biomedical shots within the DISCOVERER flight series.

III. BACKGROUND INFORMATION:

A meeting was held at the Air Force Ballistic Missile Division on 14 January 1958 for the purpose of discussing Lockheed Proposal #36899 dated 14 January 1958 which recommended acceleration of the WS 117L effort. The object of this acceleration was to obtain early reconnaissance information, using THOR-boosted vehicles and a recoverable capsule technique. As a result of this meeting Contract No. AF04(647)-181 was issued to the Lockheed Missile and Space Division on 25 January 1958 (work statement extracted as Exhibit D), calling for four flights scheduled for October, November, December 1958, and February 1959.

On 28 February 1958, see Exhibit E, the Director of the Advanced Research Projects Agency cancelled the reconnaissance aspects of the THOR-boosted phase of WS 117L and directed the Air Force to use these vehicles for biomedical experiments.

On 19 March 1958, the LMSD contract was re-oriented to include development of a recoverable capsule to accommodate a biomedical package, which is now referred to as a "life support system." The completed capsule was to be ready for flight test no later than 30 November 1958.

On 22 May 1958, the Commander ARDC sent a letter, Exhibit F, subject, "Support of Bioastronautics Program," to the AFBMD. This letter assigned Brigadier General Don Flickinger additional duty as Special Assistant to the Commander AFBMD for Bioastronautics, stating that General Flickinger would "be responsible for the direction and coordination of all the biomedical aspects of projects assigned to your organization." In addition, the letter assigned two biomedical project officers to the AFBMD, and directed the use of other competent individuals and groups in ARDC and elsewhere in an advisory role, as needed.

On 6 May 1958, see Exhibit G, the LMSD designated the General Electric Company as the subcontractor for the life support system. It was brought to the attention of all participating agencies that primary technical competence in the bioastronautics area was actually within the Air Force, and special arrangements, see Exhibit H, made the technical competence of the School of Aviation Medicine, the Aerospace Medical Laboratory (WADC), and the Aeromedical Field Laboratory (AFMDC) available to the contractor.

The G.E. life support system development comprised two models; the Mark I version, designed to carry four mice into orbit, and the Mark II version which was to have a small primate as its passenger. The first Mark I life support system, originally scheduled to fly on 30 November 1958, flew with "mechanical" mice in DISCOVERER III on 3 June 1959. The second Mark I was scheduled to fly in December 1958 and flew with live mice aboard in DISCOVERER IV on 25 June 1959. Any subsequent references in this report to the G.E. life support system are specifically directed toward the Mark II version.

The Mark II life support system, see Exhibit I, contains the following major components: life cell, air conditioner, oxygen system, electrical system, camera, feeder, air regeneration system, and clock.

The first testing of the life support system as a unit began at LMSD on 1 April 1959. Thirteen tests, see Exhibit J, of this general type have been run to date; only one of these can be considered to have met its objectives. As the testing program proceeded, it became increasingly evident to all participants that the development was encountering serious technical difficulties. These problems were reflected further in fiscal problems (roughly $2.3 million has been spent on this project to date), and in schedule slippages which are now amounting to about one year.

During the past several months numerous allegations regarding the reasons for these technical, fiscal, and scheduling problems have come to the attention of AFBMD staff members. On 29 October 1959, the Commander AFBMD directed the establishment of a Board of officers to determine the facts with regard to the following allegations:

A. "The basic design of the biomedical recovery capsule is faulty and as presently configured will not support the biomedical mission of the DISCOVERER series."

B. "Management of the biomedical test program by AFBMD, LMSD, and G.E. is grossly inadequate."

C. "Biomedical program costs being incurred by G.E. are too high and are not being subjected to proper management control."

D. "There has been inadequate utilization of available military talent within the USAF in the conduct of the biomedical program."

E. "Civilian corporations, specifically G.E., are using their particular positions in the biomedical program as a means of building their competence in the biomedical area."

Additionally, the Commander AFBMD directed the Board to make recommendations regarding:

A. The management structure of the present and future biomedical programs.

B. The technical course of action to be followed for the present biomedical program shots within the DISCOVERER series.

IV. GENERAL FINDINGS:

A. Technical Aspects of the Life Support System Development.

Witnesses appearing before the Board were in general agreement that the life support system design and test performance have been - until very recently - grossly inadequate. An inordinate amount of under-designed and non-qualified equipment has found its way into the system. Outstanding offenders in this category have been such items as oxygen regulators, the air conditioning unit, the cooling fan, the tape recorder, the camera, the timer, the feeder, the sintered absorbing plates, the electrical circuitry, and the outer housing or case.

Ironically, some of the most expensive items in this list were probably not required for successful system performance. For example, School of Aviation Medicine witnesses testify that they offered G.E. a feeder which had been built for less than $2.00 (cost of materials). The General Electric Company spent in excess of $78,000 re-inventing a feeder, eventually abandoned the effort, and is now using the School of Aviation Medicine's version. The Board noted that it is a clinical fact that the primate will not require nutrition during the flight period; the feeder appears to be "gold-plating" of the primary purpose of the life support system.

The camera is a second case in point: the Board was unable to learn who had specified the system's camera, which takes an oblique picture of a portion of the exposed chin of the primate (the rest of his face being covered by a mask). Over $100,000 has been spent in developing this special camera; it has been a difficult, time-consuming exercise, which has yet to be completed. It was noted with interest that the camera's operation requires a light to be burning at all times in a capsule which is already over-heated and under-powered.

While it is true that the adequacy of design was hampered in part by the absence of exact environmental data at flight altitude, it is the opinion of the Board that other factors were more important contributors to the life support system's inadequate design. Among these are:

1. From the very beginning, a general lack of appreciation by the contractors - prime and sub - of the complexity of the task.

2. Total inexperience on the part of both the prime contractor and the subcontractor in a difficult technical area.

3. Lack of a proper, thorough researching of the basic life support system problem.

4. No singleness of purpose in keeping the life support system as simple as possible.

5. Lack of application of scientific method in proceeding from the simple to the complex in building the life support system.

6. A curious conviction, on the part of the subcontractor's project leader, that his responsibility terminated with ground demonstration, rather than with actual flight test.

7. Inadequate provisioning of spare parts.

8. Lack of quality control of life support system equipment.

9. Lack of corrective procedures for rectifying design equipment errors and preventing identical recurrences of equipment failure.

B. Managerial Aspects of the Life Support System Development.

Having examined the technical problems associated with the life support system, the Board turned its attention to the management history of the project. Here, again, there was consensus among the witnesses that the management of this program had been exceptionally unsatisfactory.

The evidence presented to the Board indicated that a number of primary management decisions were either not made, or, if made, were not generally known to the project participants. For example, there is no clear indication of formal, official evaluation of the importance of the project. Was the life support system as important - in terms of national objectives - as ballistic missile work at the AFBMD? Was the recovery of the first living animal from satellite orbit as important an objective, and to be accorded the same all-out emphasis, as the recovery of the early ICBM/IRBM re-entry bodies?

While it is true that this project was considered to be a "crash", high-risk development, there is evidence before the Board leading to the inference that this project was not considered to be as important as other "crash", high-risk developments at the AFBMD. This view is based on the consideration that many of the key management principles applied to the ballistic missile program by the AFBMD were not used in this project.

1. A rigidly stipulated dollar ceiling was accepted in conjunction with a "crash", high-risk development to be performed in a relatively unexplored technical area. The Board has no indication that this combination of factors was protested by anyone (other than G.E.) as inherently contradictory and impractical.

2. The AFBMD's practice of deliberately establishing competitive sub-system developments in difficult technical areas was not invoked.

3. It is an accepted AFBMD practice to place officers in semi-permanent or permanent residence at those contractors' plants where serious technical problems are envisioned or experienced. It is noteworthy that in spite of the alarming state of the life support system development program no such action was taken with respect to General Electric Company.

4. In undertaking "crash", high-risk ballistic missile programs the AFBMD has considered the associate contractor system to be necessary and essential to maintaining tight technical, fiscal, and management control. The DISCOVERER system, by contrast, was organized along traditional prime contractor lines, making the General Electric Company less accessible to the AFBMD for life support system work than it is for re-entry body work.

Note

A second basic decision which the Board has been unable to identify in the project documentation or testimony is whether the School of Aviation Medicine was seriously considered as a possible developer of the life support system. The Board was deeply interested in the development history of a life support system which the SAM has fabricated for the NASA for use on experiments such as the recent biomedical flight at Wallops Island, and took particular note of testimony by the School witnesses that they had been eager to do similar work for the AFBMD. The School's witnesses estimated development costs of $120,000 vis-a-vis approximately $2.3 million already spent on the G.E. effort; if this estimate should be in error by a factor of five, it still leads to the conclusion that it would have been prudent to use the School as a second source.

The third major decision which is lacking in project history is the development of a firm position as to who at the AFBMD was in charge of what. The following chronology illustrates this observation:

1. 22 May 1958. In a letter to the AFBMD, subject, "Support of Bioastronautics Program," see Exhibit F, the Commander ARDC stated that Brigadier General Don Flickinger was being "assigned the additional duty of Special Assistant to the Commander AFBMD for bioastronautics." The purpose of this assignment was to provide the Commander AFBMD with an "in-house primary biomedical technical competence and authority." General Flickinger was made "responsible for the direction and coordination of all the biomedical aspects of projects assigned to [the AFBMD]". The Commander AFBMD was assured that "control of all aspects of this work will rest with your organization."

2. 6 June 1958. In a DF to the AFBMD, subject, "Biomedical Aspects of the Ballistic Missile Program," see Exhibit K, the Assistant

Deputy Commander/R & D, Hq ARDC, stated that "all research and development efforts contemplating the use of biological payloads on board missile or space vehicles will obtain the coordination and approval of the Special Assistant for Bio-Astronautics or his designated representative." In addition it stated that a bioastronautical organization at the AFBMD would "obtain over-all approval and coordination of the life-sciences aspect" of such projects. An unusual administrative and command-jurisdictional feature of this letter is that in it one Deputy Commander (the DC/Research and Development) at Hq ARDC presumes to assign roles and functions to a subordinate unit within the organization of another Deputy Commander (the DC/Ballistic Missiles) at Hq ARDC.

3. 12 August 1958. The Assistant Deputy Commander/Research, Hq ARDC, in a letter, subject, "Responsibilities of School of Aviation Medicine in the ARDC Biosatellite Program, Subsystem L WS 117L," see Exhibit L, advised the Commander AFBMD that representatives of Hq USAF, Hq ARDC, Air University (School of Aviation Medicine), Air Force Missile Development Center, and Wright Air Development Center had reached agreement concerning the technical responsibilities of the School of Aviation Medicine in its support of the biosatellite program, and enclosed a statement of policy for the benefit of the AFBMD. The policy statement was signed by Brigadier General Don Flickinger as the Director of the Life Sciences Directorate at Hq ARDC and states that the School of Aviation Medicine will provide biomedical criteria to the General Electric

Company, will consult on biomedical test programs and evaluate biomedical test results, and will provide continuous biomedical and biophysical technical standards liaison and consultation to the contractor. "All other decisions relative to test responsibility and conduct, engineering requirements, scheduling, time and costing functions and general welfare of the program will remain with BAD [the Bioastronautics organization with the AFBMD] or their properly designated representatives, and BAD decisions are final." In addition "direct contact is authorized between SAM and contractor." From a jurisdictional viewpoint, this correspondence was even more unorthodox than its predecessor, for now a Directorate Chief in the organization of one Deputy Commander (the DC/Research) at Hq ARDC was issuing instructions regarding roles and functions of a subordinate unit within the organization of another Deputy Commander (DC/Ballistic Missiles) at Hq ARDC. It is also noteworthy, that the Director of the Bio-Astronautics Directorate at the AFBMD was not aware of the existence of this document until it was brought to his attention by the Board, early in December 1959.

4. The AFBMD's tacit acceptance of these directives is reflected in a letter from the AFBMD's Director for WS 117L to the Lockheed Aircraft Corporation, subject, "Contract 04(644)-181, Internal Air Force Responsibilities Concerning Biosatellite Programs," dated 4 September 1958, see Exhibit H, which quoted the essence of General Flickinger's policy statement and informed LMSD that "the Bioastronautics Division (BAD) has been given managerial responsibility

~~CONFIDENTIAL~~

for all animal biosatellite programs and will act as technical direction to the contractor on biomedical aspects."

5. 13 August 1959. On this date, the Deputy Commander/Military Space Systems published a series of Functional Statements, see Exhibit M. Among these was one for the Director of the DISCOVERER Satellite System, which contained the following key statement: "Responsible to the Assistant Deputy Commander, Space Systems, for the integration of all research, development, and test aspects of the DISCOVERER Satellite System."

6. 26 October 1959. The Assistant Deputy Commander/Space Systems, in a letter to the Deputy Commander/Military Space Systems, subject, "Management of DISCOVERER Biomedical Program," see Exhibit N, stated " . . . I must as a matter of policy support the view that the Director, DISCOVERER Satellite System is basically responsible for the quality of all aspects of the DISCOVERER Program and, accordingly, must have the authority which is required to meet the responsibility assigned to him."

In an attempt to clarify management roles the Board queried each witness regarding his concept of responsibility for conducting the project. The following responses illustrate the diversity of opinion in this important area:

1. The Director of the DISCOVERER system development - Lt. Colonel Battle - believes that General Flickinger and the Director of the Bioastronautics Directorate (presently Lt. Colonel Cole) were

responsible for the life support system development until 13 August 1959, when the new Functional Statement Book appeared. Lt. Colonel Battle states that since that date he has had overall responsibility for all aspects of the DISCOVERER system. It is his opinion that General Flickinger is still the Special Assistant to the Deputy Commander AFBMD for Bioastronautics.

2. The Assistant Deputy Commander for Space Systems - Colonel Oder - agrees with Lt. Colonel Battle's interpretation of management responsibility, and testifies that he has no knowledge which would lead him to believe that General Flickinger has vacated the post of Special Assistant to the Commander AFBMD for Bioastronautics.

3. The Assistant Deputy Commander for Military Space Systems - Colonel Evans - also agrees with Lt. Colonel Battle's interpretation of his responsibilities. While he has no definite knowledge of a change in General Flickinger's role as Special Assistant to the Commander AFBMD for Bioastronautics, he speculates that some change may have occurred during the past few months as a result of the reorganization of the ARDC.

4. The Director of the Bioastronautics Directorate - Lt. Colonel Cole - testifies that he is responsible to the Commander AFBMD for the managerial and technical aspects of the biomedical portion of the DISCOVERER program.

It is a matter of fact that General Flickinger's appointment as Special Assistant to the Commander AFBMD was terminated by Department of the Air Force Special Order A-1990 on 18 November 1958; however, this fact is confusing, rather than clarifying, to the central issue. Is the Commander of AFBMD still bound by the provisions of the 6 June 1958 HF, a document which has never had jurisdictional legality, but which was not protested by the AFBMD? Was it the intention of the Deputy Commander/Military Space Systems, in the 13 August Functional Statements Book, to place the DISCOVERER Director in charge of all aspects of the DISCOVERER program? If so, what is the meaning of the expression "responsible . . . for the integration of all . . . aspects?" What is the status of the 26 October 1959 letter from the Assistant Deputy Commander/Space Systems to the Deputy Commander/Military Space Systems regarding the interrelationships of the DISCOVERER - Bioastronautics offices?

As would be expected, the absence of a strong, single, clearly designated, and universally-recognized AFBMD leader for the life support system encouraged the development of many management and technical difficulties, all of which were symptomatic of a central problem. The jurisdictional sparring which took place between LMSD and G.E. early in the program could and should have been stopped as soon as it began. The over-willingness of G.E. to respond to technical suggestions from anyone except the prime contractor could have been eliminated by the most elementary exercise of discipline. It would have been easy for a responsible agent to develop and enforce an official document which specified agency responsibilities, agency spokesmen, and inter-agency channels. Test protocols - rigidly enforced - would have done much to eliminate all-night "shall-we-proceed" sessions where decisions were made by last-minute plebiscites. Explicit count-down procedures would have spared the life support system test procedures from being characterized as "utter chaos" by the DISCOVERER test controller. A strong agent would have advised the AFBMD of any difficulties which were beyond his capability to resolve; the Board would certainly not have been exposed to contractors' briefing charts listing AFBMD and AFBAD (an old symbol for the Bioastronautics Directorate) as two separate agencies, both of whom must agree to a matter before the contractor may proceed!

C. Present Status of the Life Support System Development.

In June 1959, while visiting Vandenberg Air Force Base to observe count-down procedures, Dr. William H. Godell, of the Advanced Research Projects Agency, observed the problems which were developing in the life support system area. Upon his return to Washington, Dr. Godell contacted corporate-level G.E. officials, advised them of his deep personal concern, and asked them to undertake immediate remedial action. In August 1959, G.E. sponsored an intensive in-house review of the technical and managerial problems associated with its support of the DISCOVERER program; this investigation resulted in sweeping changes in the philosophy of, and actual conduct of, development and testing of the life support system. The Board inquired carefully into the details of this "new look" and was favorably impressed by the results to date, as well as plans for the future. Principal witnesses were unanimous in indorsing the technical direction which the new G.E. management is giving to the program; LMSD representatives stated that a wholesome air of cooperation and responsiveness now exists between themselves and the General Electric Company. There is substantial evidence to justify, for the first time, a feeling of optimism regarding the possibility of G.E.'s delivering a flight-worthy life support system within the next few months.

V. SPECIFIC FINDINGS:

The Commander AFBMD instructed the DISCOVERER-Biomedical Board to consider five specific allegations and to make recommendations on three subjects, see Exhibit C. This portion of the report deals with the Board's findings in response to these instructions.

A. Allegation A. "The basic design of the biomedical recovery capsule is faulty and as presently configured will not support the biomedical mission of the DISCOVERER series."

1. Discussion: The prime objective of the biomedical portion of the DISCOVERER series is the successful launching, orbiting, re-entry, and recovery of a live specimen. Performance to date in the test evaluation of the life support system strongly suggests Allegation A to be true. Testimony before the Board reveals that of thirteen evaluation and/or acceptance tests, only one could be considered to have reasonably demonstrated criteria for supporting the DISCOVERER program properly. Additional evidence from technically qualified scientific personnel leads to the conclusion that there has been an inordinate amount of faulty equipment integrated into the life support system, i.e. the oxygen regulators, the air conditioning unit, cooling fan, tape recorder, camera, timing mechanism, animal feeder, sintered metal absorber holders, electrical circuitry, etc. It was obvious, early in the proceedings, that inexperience, coupled with the unavailability of limiting physical (environmental) data, contributed to poor design.

For much of its history the life support system development did not follow the basic principles of scientific method. It is germane to the scientific method that clear-cut objectives be rigidly defined at the very beginning and throughout the project. Furthermore the absolute minimum number of pieces of data-gathering equipment should be bench tested exhaustively before they are incorporated into the total system. As each item passes its design criteria tests, further sophistication and instrumentation may be pursued logically, but only to the extent that system objectives are enhanced. Great care must be exercised to avoid over-design and over-complication in any system. Problem items of limited utility should be challenged early in the program and deleted as soon as possible in any urgent program. These simple methods of procedure have not been evidenced in this program - specifically in such items as camera and feeder performance, viability sensing, and in some electrical circuitry.

The Board is pleased to report that a careful in-house systems design review and critique were instituted at the General Electric Company between 27 August and 6 October 1959. The findings are now being integrated into the life support system design, to correct deficiencies and improve maintainability and accessibility. There has been a clear recognition of improper methodology and quality control; corrective procedures are being instituted to avoid recurrence of equipment failures. It is the opinion of qualified engineers that the life support system can be brought to a flight-worthy state in the near future.

2. Conclusion: Until a life support system has been completely bench checked and has successfully passed a complete laboratory count-down to simulate as closely as possible the problems of launching, orbiting, re-entry, and recovery, with thermal and noise profiles superimposed, and all integrated into the expected time sequence of a realistic mission (54 hours), a scientific capability to support the biomedical mission of the DISCOVERER series has not been demonstrated. The Board believes that the technical and managerial re-orientation of the program at G.E. is moving the development properly in the direction of such a demonstration.

B. Allegation B. "Management of the biomedical test program by AFBMD, LMSD, and G.E. is grossly inadequate."

1. Discussion: Having determined that the overall management of the life support system was under the superficial supervision of Hq ARDC personnel from project inception to sometime between November 1958 and August 1959, and perhaps to the present, the Board believes that this allegation should be expanded to provide a share of management responsibility to this particular group (Hq ARDC).

The Board's findings show three major factors contributing to the mismanagement of this project:

a. Representatives of the AFBMD, LMSD, G.E., and Hq ARDC did not research the assignment thoroughly enough to determine the state of the art of the parameters inherent in the project.

b. As a result, very unrealistic time schedules were set up and agreed to by Hq ARDC, the AFBMD, LMSD, and G.E. Fiscal planning exactly paralleled schedule planning.

c. Despite attempts at non-conventional arrangements, the prime responsibility for the project, for all intents and purposes, rested with the AFBMD. The AFBMD failed to identify one person who would be accountable for the project: a man whose decisions would be irrevocable except by the Commander AFBMD. Differences of opinion as to who was responsible for the project should have been resolved as soon as they arose. The fact that this was not done encouraged irregular managerial processes and separated responsibility from authority.

The following factors also contributed very definitely to the unsatisfactory state of the program as it existed prior to August 1959:

a. Lack of communication

b. Lack of cooperation

c. Lack of coordination

d. Lack of quality control practices

e. Failure to identify specifically the responsibilities of contributing agencies - in particular, Air Force agencies.

f. Poor design practice on the part of G.E.

g. Instability of design

h. No firm policy concerning spare parts.

i. Failure of G.E. to follow accepted industrial practice, which separates manufacturing and inspection responsibilities.

2. Conclusion: Although the testimony shows inadequate

management of the life support system by Hq ARDC, the AFBMD, LMSD, and G.E. practically from project inception in February 1958 until August 1959, the Board takes note of the recognition of an unsatisfactory state of affairs by the principals and believes that corrective actions already taken by LMSD and G.E., together with those recommended to be taken by the AFBMD in Section V, Part F, 2a and b of this report will result in an acceptably managed project in the future.

C. Allegation C. "Biomedical program costs being incurred by G.E. are too high and are not being subjected to proper management control."

1. Discussion: In reviewing the testimony before the Board, it was found that the allegation was improperly stated. All costs incurred are proper; however, it is believed that the original estimate by G.E. was not great enough to do the work in question.

The original contract, covering the period from February 1958 to projected completion in October 1959, was negotiated in the amount of $4.3 million. This covered much more than the life support system. While G.E. was verbally directed to commence work in February 1958, it was August 1958 before a Work Statement was prepared and a Letter Contract issued to General Electric by Lockheed Missiles and Space Division. The cost to date on the total G.E. effort now amounts to approximately $6.5 million, of which approximately $1.5 million has been identified as overrun. There is an additional amount reflected in a current G.E. proposal to Lockheed for $3.0 million which has not been negotiated to date. It is LMSD's position that these costs generally reflect work which was contracted for under the original contract and, as such, can be construed in the main to be additional overrun. The principal costs related to the $3.0 million proposal are from Thiokol Corporation in the amount of $335 thousand for retro-rockets, to the Burmite Company in the amount of $174 thousand for spin rockets, and for prime equipment and spares in the amount of $274 thousand. An item called Support Engineering has been included in the amount of $1.295 million. The General Electric Company agrees that it under-estimated the scope of the job to be done both from a standpoint of cost and time required. This in itself would lead one to think that the costs being incurred by General Electric are too high.

There are two specific items: namely, a feeder and a camera, which reflect costs much greater than one would have expected for items of their nature. The camera has been procured by G.E. from the Bulova Watch Company at a cost of $192 thousand; the cost of the feeder developed by General Electric amounts to $78 thousand. With respect to the camera, the School of Aviation Medicine witnesses state that in their opinion this item is not needed and should not have been included in the life support system. The feeder presently used by the General Electric Company is not the feeder for which the costs have been incurred by G.E., but one which was fabricated by the School of Aviation Medicine. School personnel believe that a feeder could have been adequately designed and produced for less than $1,000.

These two items, according to School of Aviation Medicine witnesses, were good reasons for stating that the costs incurred by G.E. were excessive, and they stated that it was their belief that the entire life support system could have been built by the School for $120 thousand.

LMSD stated that it believed that technical management control of the biomedical program by the General Electric Company was inadequate. This statement was based upon the inability of General Electric to meet the schedule and further was reflected by problems incurred in the life support system equipment. LMSD did believe the financial control of the program to be adequate.

2. Conclusions: Costs incurred by General Electric Company in the development of the life support system greatly exceeded G.E. original estimates. Because of an under-estimate of the technical task to be accomplished, greater costs were incurred than would have been the case if a better appreciation of the task to be performed had been realized from the beginning. Further, there was inadequate technical management control in the program because of the inability of G.E. to recognize in the beginning the magnitude and scope of the task to be performed.

D. Allegation D. "There has been inadequate utilization of available military talent within the USAF in the conduct of the biomedical program."

1. Discussion: There is no doubt from the Board review

of records and testimony that USAF biomedical talent has been used liberally in the conduct of the life support system development. How *effectively* the talent was used has become the dominant question.

Life support system design efforts began in March 1958 with the re-orientation of the DISCOVERER program. From the beginning the AFBMD followed the ARDC policy of calling on Air Force biomedical talent, and established a working relationship with the School of Aviation Medicine, the AFMDC, and the WADC for support of this program. Later in the program, the 8 August 1958 ARDC directive, see Exhibit L, was issued, defining the responsibilities of the School of Aviation Medicine.

In spite of this attempt to formalize and emphasize the blue-suit contribution to the life support system development, it is clear from testimony before the Board that the actual use of military biomedical talent left much to be desired. Some major factors contributing to this situation are:

a. A lack of harmony among the organizations involved. Prime-subcontractor friction; the absence of a powerful, central directing agent; concern over jurisdictional prerogatives; personality conflicts and clashes; and other complex reasons contributed to a deteriorating working-level relationship among the principals, and inhibited the effective use of available military talent.

b. The over-riding consideration of meeting an iron-clad schedule always stimulates friction, and this development was no exception. In cases where design and testing methodologies diverged, it was frequently felt that precious time could not be diverted to building rapport among the contributing organizations. This led to a cyclical, self-generating problem situation where it became increasingly difficult for any of the participants to work efficiently and harmoniously.

c. Misunderstandings as to organizational responsibilities and management relationships, which affected the motivations of the people involved.

d. Serious underestimation of the technical task on the part of design and technical direction contractors, which further aggravated the already-complicated test and design environment.

e. Changing design criteria of the life support system because of newly discovered environmental conditions, coupled with a very tight development schedule, which encouraged the use of short-cut test plans and procedures, and often ignored the talent available for conducting these tests.

2. Conclusion: USAF personnel have been used liberally in the life support development; however, in many cases, and particularly in the case of School of Aviation Medicine personnel, the use has been inefficient, ineffective, and sometimes inconsiderate. One of the prime responsibilities of the AFBMD's life support system agent should be to re-establish rapport with the School of Aviation Medicine.

E. Allegation E. "Civilian corporations, specifically G.E., are using their particular positions in the biomedical program as a means of building their competence in the biomedical area."

1. Discussion: During the second day of the hearing

SECURITY CLASSIFICATION (If any)

R+D 1c

DISPOSITION FORM

FILE NO.

SUBJECT Biomedical Aspects of the Ballistic Missile Program

TO WDTS

FROM RDTHA

DATE 6 June 58

COMMENT NO. 1

Lt Col Cain/kl/4145

1. Special Orders Number A-920, Department of the Air Force, 9 May 1958, assigned Brigadier General Donald D. Flickinger, Staff Surgeon and Director of Human Factors, Headquarters ARDC, to an additional duty, Special Assistant for Bio-Astronautics to the Deputy Commander for Ballistic Missiles, ARDC.

2. All research and development efforts, contemplating the use of biological payloads on board missiles or space vehicles, will obtain the coordination and approval of the Special Assistant for Bio-Astronautics or his designated representative.

3. To provide the Ballistic Missile Division with timely life sciences support in the coordination of procurement data, monitorship of contractor efforts, and supervision of inspection tests of components of life supporting and bio-performance measuring equipment, technically qualified life sciences personnel will be placed on TDY or will be assigned to the Ballistic Missile Division. These personnel will be authorized to render decisions regarding the adequacy of life supporting equipment and other technical problems concerned with viable payloads. This headquarters, ATTN: RDTH, will be informed of all decisions in this area. In addition, a monthly progress report on the development, fabrication, testing, and scheduling of the life sciences portion of the program will be provided.

4. A significant portion of the nation's life sciences capability in support of space operations is contained in certain Air Force medical and behavioral sciences research and development organizations. Certain of these agencies are hereby designated as points of contact for the weapons systems management organization and contractors concerned with development and fabrication of life supporting equipment and life sciences experiments. The designation of these units is for the primary purpose of assuring that the contractor has the latest information available for incorporation into his design, and secondly, to assure the fabricated unit meets the technical criteria as established by the Air Force. The bio-astronautical members of the Ballistic Missile Division will obtain over-all approval and coordination of the life sciences aspect of the project. But, in so doing, will consult freely and frequently with the designated units, assuring that liaison is being maintained with the prime contractor and subcontractors on the technical biomedical and bio-performance problems associated with the projects.

a. Aeromedical Laboratory (WADC)

(1) Determination of the biological adequacy of subassemblies, technical specifications for the internal life support environment, and the normal technical development program responsibilities of the laboratory for such environments.

1-6-149

EXHIBIT K

96 REPLACES NME FORM 96, 1 OCT 48, WHICH MAY BE USED.

16—84801-8 ★ U.S. GOVERNMENT PRINTING

the Board was advised by School of Aviation Medicine witnesses that this allegation did not properly express the thought they had in mind. It was pointed out that the School does not object to the growth of biomedical competence; its real objection is to the exploitation of non-biomedical personnel in attempting to achieve such competence. An example would be the use of physicists and engineers, rather than physicians and physiologists, in designing the life support system.

2. Conclusion: In the light of this explanation, the Board determined that Allegation E was more properly considered as part of Allegations B and D, and gave it no further separate treatment.

F. Directed Consideration A. "You are enjoined to make recommendations regarding the management structure of the present biomedical program and any suggestions for future follow-on biomedical programs."

1. Discussion: The Board believes that the primary requirement for increasing the managerial effectiveness of the present biomedical program is the designation of a single project director. Once such an appointment has been made, the director, and he alone, should be charged with the responsibility for establishing clear, formal arrangements among all project participants, including test protocols, definite count-down procedures, the designation of single spokesmen for all agencies, and similar matters. The director should be charged specifically with the responsibility for maintaining strict discipline

among the participants, and should be enjoined to make a special effort toward re-establishing rapport between technical personnel of the AFBMD and the School of Aviation Medicine.

With regard to future biomedical programs, the Board recommends similar management actions which would prevent many of the problems encountered in the present program.

a. The Commander AFBMD should designate a project director at the inception of any future projects. The project director should be empowered to, and directed to, make all AFBMD decisions on the project.

b. All participating agencies should be required to designate single spokesmen who exercise the same control in their organizations as the project director does for the AFBMD.

c. Definite test protocols and count-down procedures should be established far in advance of the need date, and should be regarded as iron-clad operating procedures by all participants.

2. Conclusion and Specific Recommendation: Testimony before the Board shows the need for (a) making maximum use of Air Force biomedical know-how in developing the life support system and (b) eliminating jurisdictional and functional disagreements between the Director of DISCOVERER and the Director of Bioastronautics. The Board notes that between 80 and 90% of the work of the Bioastronautics Directorate is in support of the DISCOVERER project. Having considered these factors, the Board makes the specific recommendation that the following actions be taken concurrently:

a. That the Director of the Bioastronautics Directorate be designated immediately as the single AFBMD spokesman, i.e., Project Director, for the Mark II Life Support System.

b. That the Bioastronautics Directorate be transferred immediately to the Assistant Deputy Commander for Space Systems.

C. Directed Consideration B. "Specific recommendations as to the technical course of action to be followed for the present biomedical program shots within the DISCOVERER series are required."

1. Discussion and Conclusions: A significant gain to national prestige as well as an important scientific contribution will result from the recovery of a live specimen from a polar orbiting vehicle. Notwithstanding the fact that time is a most important concern in conserving the prestige of the occasion, certain limits must be imposed on firing dates. Specifically:

a. The biomedical life support system must demonstrate reproducible evidence that it can in fact support a live specimen for the total mission profile.

b. The recovery package design and technique must be adequately demonstrated, based upon actual recovery from orbit.

c. The competence of all participants must be demonstrated in count-down procedures compatible with established launch controller requirements.

VI. GENERAL CONCLUSIONS

A. Technical.

1. A life support system cannot be considered to have met its ground test until it has been completely bench checked and has successfully passed a complete laboratory count-down which simulates as closely as possible the problems of launching, orbiting, re-entry, and recovery, with thermal and noise profiles superimposed, and all integrated into the expected time sequence of a realistic mission. The DISCOVERER life support system has not met these criteria as yet, but under G.E.'s "new look" design and testing philosophy is definitely moving in this direction.

B. Managerial.

1. "Crash", high-risk developments involving relatively unexplored technical areas should be:

   a. Financed by requirements budgets rather than ceiling budgets.

   b. Encouraged to sponsor competitive sub-system developments in any difficult technical areas.

   c. Organized so that all contractors working in difficult technical areas are as accessible as possible to AFBMD direction and control.

   d. Supported by in-residence AFBMD personnel at any contractor's plant where the development item is "pacing" or technically difficult.

None of these conditions have been applied to the life support system development.

2. A strong, single universally-recognized AFBMD leader should be appointed at the inception of all projects if the project is to succeed. This has not been done for the life support system development.

3. Test protocols must be developed far enough in advance of a test series to assure their acceptance as doctrine at the test itself. This has not been done for the life support system development.

4. Clear functional statements and designated single spokesmen are required for all agencies involved in a development or test if inefficiency, ineffectiveness, bickering, accusations, and counter-accusations are to be prevented. Specific designations of responsibility, by name, do not exist in the life support system development.

VII. GENERAL RECOMMENDATIONS

A. Technical.

1. That the AFBMD recognize the G.E. "new look" in design and testing as a proper, albeit long over-due, methodology for developing a flight-worthy life support system.

2. That the schedule for the flight of a life support system be based upon a clear demonstration, in ground tests, that the system can sustain a live specimen for the total mission profile and a clear demonstration, based upon actual recovery from orbit in flight test, that the recovery equipment meets its operating requirements.

B. Managerial.

1. That a strong, single, clearly-designated leader be appointed at the inception of all development projects. This leader must be held responsible for organizing the participation of all agencies in a well-disciplined, harmonious manner.

2. In the specific case of the Mark II life support system development, this Project Leader should be the Director of the Bioastronautics Directorate; the Directorate itself should be transferred immediately to the Assistant Deputy Commander for Space Systems.

3. Comprehensive iron-clad test protocols and count-down procedures should be developed at once for the life support portion of the DISCOVERER program.

4. Clear functional statements and a list of officially-designated single spokesmen should be developed by the Project Director for all agencies participating in the life support system development.

5. A special effort should be made, under the leadership of the Project Director, to re-establish rapport between technical personnel of the AFBMD and the School of Aviation.

PAUL E. WORTHMAN, President
Colonel, USAF

JOHN E. PICKERING, Member
Colonel, USAF

JAMES S. SEAY, Member
Lt. Colonel, USAF

FRED BERNER, Member

WILLIAM H. WEAVER, Recorder
Major, USAF

HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

SPECIAL ORDERS)
NUMBER. 20)

27 November 1959

Under the provisions of AFBMDIR 11-6, AFR 14-6, AFR 11-1, AFR 120-3, and at the written direction of Commander, Air Force Ballistic Missile Division, the following named individuals are appointed to an Investigating Board on an ad hoc basis, for the purpose of reviewing the management and technical status of the biomedical project currently associated with the DISCOVERER Program. Upon submission of the Board report and approval by the Commander, Air Force Ballistic Missile Division, the board is dissolved. In the absence of the President the senior member present at the meeting will act as President and in the absence of the Recorder, the junior present will perform the duties of the Recorder. The Recorder will notify the Director of Administrative Services when the Board is dissolved.

*COL LEO P. GEARY, 8037A	HQ USAF	President Voting
COL PAUL E. WORTHMAN, 7324A	HQ AFBMD	Member Voting (Alt. President)
*COL JOHN E. PICKERING, A0724350	SCHOOL OF AVIATION MEDICINE	Member Voting
*LTCOL JAMES S. SEAY, 12319A	HQ AMC(BMC)	Member Voting
LTCOL RAYMOND E. ZELENKA, 12701A	HQ AFBMD	Member Voting
MAJ WILLIAM H. WEAVER, 14813A	HQ AFBMD	Member Voting (Recorder)
*DR. FRED BERNER	WRIGHT AIR DEVELOPMENT CENTER (BIOMED LAB)	Member Voting

*With concurrence of respective Commander.

FOR THE COMMANDER:

E. L. JACKMAN
Lt Colonel, USAF
Dir of Administrative Services

DISTRIBUTION:
2 - Ea Indiv (14)
50 - Recorder
1 - WDCA
1 - WDAAO
1 - WDGE
1 - WDGEH
5 - WDT
5 - WDZ
5 - WDF
3 - WDPMO
5 - WDC
5 - WDL
5 - AC (SAC MIKE)
5 - ATC
2 - LBMA
1 - BSED (AU)
1 - WDAS

HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

SPECIAL ORDERS)
NUMBER 31)

1 December 1959

1. Under provisions of AFR 60-18, MAJ IVAN H DETHMAN, 14258A, HQ AFBMD. Los Angeles, Calif is attached to Los Angeles Air Defense Sector, Norton AFB, Calif for the purpose of maintaining flying proficiency.

2. The verbal order of the Commander on 25 Nov 59, authorizing A/1C LARRY K WALKUP, AF13294151, 6592d USAF Dispensary, ARDC, Los Angeles, California, BAS at the rate of $2.57 per day effective 1600 hours, 25 Nov 59, under the provisions of paragraph 20101D, AFM 173-20, is confirmed. Exigencies of the service having been such as to preclude the issuance of competent written orders in advance.

3. Special Orders Number 20, this Hq, dated 27 Nov 59, relating to the establishment of an Investigating Board on an ad hoc basis for the purpose of reviewing the management and technical status of the biomedical project currently associated with the DISCOVERER Program, is amended to delete so much as pertains to COL LEO P GEARY, 8037A, HQ USAF, and is further amended so much as reads: "COL PAUL E WORTHMAN, 7324A, HQ AFBMD. Member Voting (Alt. President)" is amended to read: "COL PAUL E WORTHMAN, 7324A, HQ AFBMD, President Voting".

4. MAJ FRANK R DEAN, 33846A, (Expense Code 4591100), HQ AFBMD, ARDC, Los Angeles, California, will proceed on or about 2 Dec 59 to USAF Hospital, March AFB, California on TDY for approximately 1 day for the purpose of medical consultation; and upon completion will return to Hq Air Force Ballistic Missile Division, Los Angeles, California. TPA. This mode of transportation has been determined to be more advantageous to the Government. TDN. 57x3600 047-9624 P690 S594200 0212. Authority: Chapter 16, AFM 35-11.

FOR THE COMMANDER:

E. L. JACKMAN
Lt Colonel, USAF
Dir of Administrative Services

DISTRIBUTION:
2 - Ea Indiv (para 1, 2 & 3)
10 - Maj Dean
50 - Recorder (Para 3)
5 - WDPMO
5 - WDPMA
1 - WDCA
1 - WDCAF
1 - WDAAO
2 - WDQF
1 - WDQHA
1 - WDCS
1 - WDGE
1 - WDGEH
5 - WDT
5 - WDZ
5 - WDF
5 - WDC
5 - WDL
1 - WDAS
5 - AC (SAC MIKE)
5 - ATC
2 - LBMA
1 - BSED (AU)
5 - Commander
LA Air Defense Sector
Norton AFB, California

LIST OF WITNESSES

NAME	AFFILIATION	RANK	SERIAL NUMBER
John T. Hart	LMSD		
Stanley A. Hall	LMSD		
Harry A. Gorman	SAM	Colonel, USAF	19007A
Robert T. Clark	SAM	Dr.	
E. A. Miller	G.E.		
E. S. Miller	G.E.		
A. A. Little	G.E.		
Fred Parker	G.E.		
Robert W. Anderson	G.E.		
Robert W. Roy	AFBMD F.O. VAFB	Captain, USAF	22332A
James W. Plummer	LMSD		
Leonard C. Ransler	LMSD		
Erwin R. Archibald	AFMDC	Captain, USAF	25685A
Clarence L. Battle	AFBMD	Lt. Colonel, USAF	6209A
Albert W. Johnson	AFBMD.	Captain, USAF	22226A
Frederick C. E. Oder	AFBMD	Colonel, USAF	7684A
Harry L. Evans	AFBMD	Colonel, USAF	4619A
Edward L. Cole	AFBMD	Lt. Colonel, USAF	6563A

AIR FORCE BALLISTIC MISSILE DIVISION
HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

REPLY TO ATTN OF: WDG

SUBJECT: Investigating Committee

29 October 1959

TO: WDZ (Colonel Curtin)

1. For several months I have been concerned with the progress of the biomedical mission of the Discoverer series. In the past few weeks, several complaints have been relayed to me from various sources. Accordingly, I should like you to establish a board of officers to thoroughly investigate the allegations. These allegations are as follows:

a. The basic design of the biomedical recovery capsule is faulty and as presently configured will not support the biomedical mission of the Discoverer series.

b. Management of the biomedical test program by AFBMD, LMSD, and GE is grossly inadequate.

c. Biomedical program costs being incurred by GE are too high and are not being subjected to proper management control.

d. There has been inadequate utilization of available military talent within the USAF in the conduct of the biomedical program.

e. Civilian corporations, specifically GE, are using their particular positions in the biomedical program as a means of building their competence in the biomedical area.

2. In addition to determining the truth of these allegations, you are enjoined to make recommendations regarding the management structure of the present biomedical program and any suggestions for future follow-on biomedical programs. In addition, specific recommendations as to the technical course of action to be followed for the present biomedical program shots within the Discoverer series are required. The board of officers should be composed of personnel from Hq USAF, Hq ARDC, SAM, BMC, and AFBMD. The board should be constituted and convened at the earliest possible date with recommendations to be forwarded to me not later than 20 November 1959.

O J Ritland

O. J. RITLAND
Major General, USAF
Commander

Extract from Amendment #2 to Letter Contract AF 04(647)-181 dated 16 May 1959.

a. Item 3 of Exhibit is revised to read:

"Physical Recovery System in accordance with Exhibit B attached hereto and made a part hereof."

b. Subparagraph 6 of Exhibit B is revised to read:

"Develop a recoverable capsule to accommodate an aero-medical package for use with the Pioneer vehicle. The complete capsule shall be available for flight-test no later than 30 November 1958.

Exhibit 'D'

SECRET ~~CONFIDENTIAL~~

Extract from Contract AF 04(647-181) definitized 6 January 1959
Date Contract awarded: 25 January 1958

2.5.10.1.1.4 The Contractor shall be responsible for:

a. Ground and flight test data analysis and reduction.

b. The engineering evaluation of the overall reconnaissance system and provision of the results to the appropriate organization for use in future designs.

2.5.11 Biomedical Capsule (Subsystem L)

2.5.11.1 Item I - Research and Development

2.5.11.1.1 Biomedical Data. This data shall be obtained by the selection of suitable vertebrate specimens and environmental instrumentation, as permitted by the WS-117L payload weight limitations, with the primary objectives of demonstrating specimen survival and cosmic radiation effects.

2.5.11.1.2 The WS-117L design modification shall be accomplished as required to maintain the recovery capsule program current. The auxiliary power system shall be arranged to provide electrical power required by the capsule during the ascent and orbiting flight phases.

2.5.11.1.3 Recovery Capsule. The Contractor shall design as required by the conditions of re-entry and shall include suitable equipment for the survival of the biomedical specimen and for the recovery of cosmic radiation and biomedical environmental data. The capsule shall be equipped with beacon, dye marker, and strobe lamp equipment as considered feasible to facilitate the search and recovery operation.

2.5.11.1.3.1 The Contractor will develop and design the complete Biomedical Recovery Capsule including the necessary components, subassemblies, and retro-rocket system. Government technical agencies will provide available technical advice, biological specimen performance, environmental requirements, biological specimen tests, and shall approve the environmental provisions of the capsule assembly.

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

~~CONFIDENTIAL~~ SECRET

2.5.11.1.3.2 The BRC shall be designed, insofar as possible, to assure the launch, orbit, and recovery of the viable animal subjects and instrument subassemblies. Conditions shall be provided so that the animal subjects will have suffered no irreversible damage except that damage ascribable to prolonged weightlessness and cosmic radiation.

2.5.11.1.3.3 The Biomedical Recovery Capsule assembly shall consist of the following major assemblies:

a. Shell Assembly. A shell assembly shall be designed for assurance of the structural integrity under the stress conditions encountered during boost, orbit, and recovery, and shall provide the necessary design characteristics to ensure thermal heat balance during flight.

b. The capsule shall include a recovery package complete with radio beacons, strobe lights, radar chaff dispensers, dye markers, parachutes, and the auxiliary equipment necessary to ensure the maximum opportunity for location and recovery.

c. Environmental Controls. The environmental subassembly shall include the necessary nutrients, water, atmospheric conditions, temperature, and pressure to assure adequate life conditions for the selected viable specimen.

d. Capsule Internal Structure. The capsule internal structure shall be so designed that the acceleration forces of boost, re-entry, and impact will be within the tolerances of the viable specimen selected. This internal structure shall also provide for acceptable environmental temperature conditions.

e. Instrumentation. Instrumentation shall be provided to include a minimum of the following data:

1) Ascent and Orbit Interval
   a) Capsule air temperature
   b) Capsule air pressure
   c) Oxygen pressure
   d) Capsule humidity
   e) Viability indication (desirable but not mandatory)
   f) Camera coverage (desirable but not mandatory).

2) Re-entry Interval
    a) Capsule air temperature
    b) Acceleration in 3 orthogonal planes
    c) Oxygen pressure
    d) Capsule pressure
    e) Noise level
    f) Viability indication (desirable but not mandatory)
    g) Camera coverage (desirable but not mandatory).

Adequate instrumentation for the recovery of data in accordance with the flight test objectives of paragraph 2.5.11.3.3 shall also be provided.

f. Retro-rocket Equipment. The capsule assembly shall include the necessary retro-rocket equipment for the initiation of re-entry.

g. Electrical Power. Adequate electrical power shall be included for the operation of internal capsule equipment.

2.5.11.1.4 Search and Recovery Operation. A program will be planned, developed, and coordinated to initiate the recovery of the re-entry capsule, with consideration being given to primary "air snatch" operations as well as water and land recovery plans. To ensure a communication system and arrange for the transmission of biomedical data by means of the telemetering system and for the initiation of the capsule re-entry and recovery phase through suitable command programmer arrangements, adequate coordination must be assured. Adequate coordination must also be assured to plan for tracking the package over a sufficient portion of the trajectory to permit recovery.

2.5.11.1.5 Environmental Performance Specifications. The purpose of this specification is to outline the environmental parameters necessary to support life in the BRC. The maximum or minimum values stated below cannot usually be regarded as optimum for homeostasis; therefore, when possible, optimum values will be presented. The Contractor will make every reasonable effort to achieve the optimum values during any phase of flight and will not exceed maxima or minima at any time after launch. A 14.7 psi pressure schedule is acceptable prior to launch, and, if used, will consist of approximately 730 mm Hg partial pressure oxygen, 10 mm Hg partial pressure water, 10 mm Hg partial pressure inert gas, 8 mm Hg partial pressure carbon dioxide and 3 mm Hg partial pressure other gases.

a. Total Pressure. The pressure of the enclosed environment will not be less than 5.0 psi (258 mm Hg) nor more than 10.10 psi (522 mm Hg). The optimum value is 5.0 psi unless contraindicated by engineering requirements.

b. Oxygen Partial Pressure. The partial pressure of oxygen will not be less than 150 mm Hg nor more than 300 mm Hg.

c. Carbon Dioxide Partial Pressure. The partial pressure of carbon dioxide will not exceed 8 mm Hg at any time. Any value less than this is optimal.

d. Water Partial Pressure. Partial pressure of water vapor may vary between 5 mm Hg and 10 mm Hg. 10 mm Hg is optimal.

e. Biologically Inert Gas Partial Pressure. The inert gas found in the enclosed environment may be either nitrogen or helium. Partial pressure of the gas used will not be more than approximately 190 mm Hg. The optimal value is 10 mm Hg.

f. Other Gases. Other gases present such as hydrogen sulfide, indoles, skatoles, etc. will not exceed 3 mm Hg.

g. Toxins. Endogenously produced toxins (other than biological) such as battery gas, lithium hydroxide dust, etc. will be excluded or filtered from the system. Other toxins which may be produced by exogenous phenomena in orbit, e.g., ozone, need not be controlled.

h. Temperature. The air temperature of the enclosed environment will be maintained between 55° and 85° F. The optimum temperature is 70° F. Temperature peaks during re-entry will not exceed 120° F for 5 minutes nor 100° F for 30 minutes. Wall temperatures of the bio-pack may rise to values higher than this for correspondingly briefer periods of time, but should be maintained at levels unlikely to produce tissue damage on contact.

i. Time. The environment described above will be maintained for at least 84 hours for Missions A B, C, and D and at least 132 hours for Mission E.

j. Acceleration. All accelerative forces imposed on the animals will lie under a curve described by the following time-dwell versus 'g' coordinates: 70 g's for .1 sec; 35 g's for 1 sec; 18 g's for 10 sec; 9.5 g's for 100 sec; 5 g's for 1000 sec.

2.5.11.1.6 Ground Support Equipment. Ground support equipment shall be designed for the preparation, checkout, and installation of the recovery capsule system.

2.5.11.1.7 Data Reduction. Machine analysis of telemetered data will be performed.

2.5.11.1.8 Test Plan. A test plan outlining the acceleration, vibration, noise, environmental simulation, and drop recovery tests to be performed on components, subassemblies, and full assemblies, will be submitted to the Government for approval. The test plan will also indicate the use of animals and Contractor available test facilities, and the desired use of the Government test facilities needed to implement the test program.

2.5.11.1.9 Prior Approval. Rough drawings, "first approximation" data, specifications, plans, informal presentations, etc. will be submitted to the Government for approval prior to purchase, fabrication, or assembly of components, subassemblies, and full assemblies.

2.5.11.2 Item II - Hardware

2.5.11.2.1 Biomedical subsystems shall be produced as further defined in this paragraph to satisfy the requirements of the program as enumerated in Section 1.0 of the Work Statement. Biomedical Recovery Capsule assemblies shall be fabricated with the necessary spare units and test articles to support a series of five flight experimental programs indicated in the following tabulation.

SHOT	PURPOSE	ANIMAL	INFORMATION AND INSTRUMENTATION
A	Survival and Recovery	(4) Mice (4C-57)	Temperature, total pressure, oxygen bottle pressure, acceleration, noise level, humidity, viability, cosmic radiation
B	Survival and Recovery	(4) Mice (4C-57)	Same as A
C	Survival and Recovery	(1) Rhesus Monkey	Same as A plus psycho-operant task
D	Survival and Recovery	(1) Rhesus Monkey	Same as C
E	Survival and Recovery	(1) Rhesus Monkey	Same as C

2.5.11.2.2 Ground support equipment, as described in Paragraph 2.5.11.1.6 shall be produced.

2.6 COORDINATION OF SUBSYSTEM A THROUGH H WITH SUBSYSTEM I, "DATA PROCESSING" SUBSYSTEM

In order to ensure optimum design and development of the complete WS-117L system and the proper meshing of applicable portions of Subsystems A through H with Subsystem I, the Data Processing Subsystem, LMSD and the Prime Contractor SS/I will collaborate to make arrangements for a sufficiently full and timely flow of information from each project to the other and from each set of subcontractors to the other, as their work affects the interfacial areas. They will jointly arrange orderly means to bring to light any divergencies between the two parts of the total program, to effect the best possible compromises as they are needed, and to refer to the Government Contracting Officers (LMSD to BMO and Prime Contractor SS/I to RADC) for decision on any questions that cannot be

2.2.2.6 Visual Surveillance Program

2.2.2.6.1 The Visual Surveillance Program consists of the development of a continuous surveillance system at ground resolutions equal to or better than that obtained with the Advanced Visual Reconnaissance Program.

2.2.2.7 Ferret Surveillance Program

2.2.2.7.1 The Ferret Surveillance Program consists of the development of a surveillance type ferret as well as a Quick Reaction Capability (QRC). It will be an integrated ferret system that provides the capability of varying the frequency bands and other signal parameters of interest by command through the ground-space communications link.

2.2.2.8 Biomedical Recoverable Capsule Program

2.2.2.8.1 The Biomedical Recoverable Capsule Program shall have the dual objectives of gathering biomedical data and establishing successful re-entry and recovery from orbit of selected living specimens.

2.2.3.12 Biomedical Capsule (Subsystem L)

2.2.3.12.1 The Biomedical Program consists of a satellite-borne capsule, suitable vertebrate specimens and equipment that will collect and transmit biomedical data by telemetering and ensure successful specimen survival after re-entry and recovery from orbit.

2.2.3.13 Personnel Subsystems. By definition, a personnel subsystem exists whenever any of the above subsystems, or the booster subsystem, requires the interaction of personnel. A properly designed personnel subsystem consists of the following components: (a) Human engineering to insure optimum man-machine compatibility. (b) Determination of the kinds and numbers of personnel required to operate and maintain the associated hardware subsystem. (c) Training and training equipment required to obtain suitably trained personnel. (d) Appropriate personnel supports in the form of technical manuals and other job aids.

To distinguish between personnel subsystems developed for Contractor personnel in contrast to Air Force personnel, the terms "Contractor Personnel Subsystems" and "Air Force Personnel Subsystems" are used.

~~SECRET~~

OFFICE OF THE SECRETARY OF DEFENSE

WASHINGTON 25, D. C.

28 February 1958

MEMORANDUM FOR: SECRETARY OF THE AIR FORCE

SUBJECT: RECONNAISSANCE SATELLITES AND MANNED SPACE EXPLORATION

1. Reference is made to the Air Force Proposal for Accelerating military reconnaissance satellites and outer space vehicle projects discussed in your memorandum dated 12 November 1957, and your memorandum of 1 February 1958 requesting that continuation of the Air Force military reconnaissance project be clarified.

2. I have reviewed your proposal in consultation with the Director of Guided Missiles, The Special Assistant to the President for Science and Technology, and the Director of Central Intelligence. In our review we have been guided by the following general policy considerations:

a. The Department of Defense must be alert to avoid within and between the services any unnecessary duplication of military and scientific space projects. even though some degree of risk is thereby involved, in order that funds and other resources may be available for the large variety of absolutely essential programs.

b. The scientific and engineering capabilities of each of the military departments must be used with maximum effectiveness and efficiency. No single military department should be overloaded with too many high priority, crash programs.

c. In addition to its missile programs, the Air Force is responsible for the 117L Advanced Reconnaissance System and has a recognized long term development responsibility for manned space flight capability with the primary objective of accomplishing satellite flight as soon as technology permits. It is important to achieve an adequate concentration of effort and energy within the Air Force on these programs with a minimum diversion of attention and of resources to lower priority projects.

3. On the basis of the foregoing general considerations as well as of more specific technical judgments, I have arrived at the following conclusions on the points raised in the two above referenced memoranda.

a. The ATLAS 117L project should be accelerated and carried forward under the highest national priority in order to attain an initial operational capability at the earliest possible date.

b. The proposed interim reconnaissance system made up of a Thor booster combined with a second stage which carries a lightweight payload in the form of a recoverable capsule, duplicates rather than complements the ATLAS 117L capability. The interim system would give only a small improvement in time over the ATLAS 117L. Moreover, the successful and continuous operation of a recoverable reconnaissance system, with the attendant requirement for search, appears infeasible from a practical and useable military point of view. Accordingly, the development of the interim system should not be pursued.

c. In order to attain early flights of the Lockheed vehicle to be employed as the second stage in the 117L system, it may be desirable for the Air Force to plan for test firings of this vehicle utilizing a THOR booster, since an adequate number of these less expensive boosters can be made available for this purpose sooner than the ATLAS booster will be available.

d. I understand that a THOR booster with a suitable second stage vehicle may be the most promptly and readily available device for experimental flights with laboratory animals. The development of such hardware is authorized, including provision for the recovery of the animals, in furtherance of the objective of manned satellite flight.

S/ Roy Johnson

DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY

HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
Andrews Air Force Base
Washington 25, D. C.

File

ADDRESS REPLY TO
COMMANDER, ARDC ATTN
RDZGH

22 MAY 1958

SUBJECT: (U) Support of Bioastronautics Program

TO: Commander
Air Force Ballistic Missile Division (ARDC)
P. O. Box 262
Inglewood, California

1. In partial implementation of the authority granted under paragraph 3d, Memorandum for the Secretary of the Air Force from the Director, Advanced Research Projects Agency, OSD, 28 February 1958, subject, "Reconnaissance Satellites and Manned Space Exploration," and in the interests of an expeditious start to the investigation of the biomedical aspects of manned spaced flight, it is desired that steps be taken to include bioastronautics support as a secondary objective in from three to five of the planned THOR-boosted WS-117L flights which are scheduled to begin in November 1958. ~~(SECRET)~~

2. To provide you with an in-house primary biomedical technical competence and authority, Brig. General Don Flickinger is now assigned the additional duty of Special Assistant to the Commander, AFBMD for bioastronautics and as such will be responsible for the direction and coordination of all the biomedical aspects of projects assigned to your organization. In addition, two biomedical project officers are being permanently assigned to your Space Systems Division to provide necessary technical competence on a continuing basis. It is expected, of course, that you will also make use of other competent individuals and groups in the Air Research and Development Command and elsewhere in an advisory role, as needed. ~~(SECRET)~~

3. In order that this biomedical work will interfere as little as possible with WS-117L development and testing, control of all aspects of this work will rest with your organization. It is further desired that in the interest of conserving time and resources, the AFBMD will, insofar as possible provide support to this work within the existing WS-117L contractual structure. ~~(SECRET)~~

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

~~SECRET~~

~~CONFIDENTIAL~~

C8-120892

WD-58-03427

EXHIBIT F

B/L to AFBMD, Subject, "(U) Support of Bioastronautics Program"

4. I am directing the necessary action to provide an additional budget authorization and allotment of $449,000 of FY 1958 P-600 funds to your organization to cover the biomedical aspects of the efforts already underway in the WS-117L Program. In addition, $100,000 has been transferred from the School of Aviation Medicines' resources (line 780A-7851) to your organization. (~~UNCLASSIFIED~~)

5. It will be necessary for you to take action to insure that ARPA programs additional FY 1959 funds of all types (P-600 R&D; P-600 Operation and Management; and non-P-600 funds) to cover the cost of continued effort in the WS-117L Biomedical Recoverable Capsule activity. The FY 1959 P-600 R&D funds to be programmed for this purpose total $6 million and will cover the cost of development, design and fabrication of the recoverable capsule, animal container, instrumentation and telemetry, associated recovery equipment, conduct of the recovery operation, etc. The FY 1959 requirements for P-600 Operation and Management funds and non-P-600 funds have not been established as yet. ~~(SECRET)~~

S. E. Anderson

S. E. ANDERSON
Lieutenant General, USAF
Commander

~~CONFIDENTIAL~~

Missile Systems Division * Sunnyvale, California

6 May 1958

In Reply Refer to:
LMSD/56989
WS117L/32

Subject: Contract No. AF 04(647)-181
Biosatellite Flight Program Plan

To: Commander
Air Force Ballistic Missiles Division
Hdqtrs., Air Research and Development Command
Attn: Col. F.C.E. Oder (WDTSR)
P. O. Box 262
Inglewood, California

Reference: (A) AFBMD TWX to LMSD, dtd. 11 March 1958, (LMSD/37894)

(B) Letter Contract AF 04(647)-181, dtd. 25 January 1958, (LMSD/37125)

1. The TWX of Ref. (1) from AFBMD to LMSD redirected the efforts of the 117L program under the letter contract Ref. (2) to include biosatellite flights as secondary objectives of the IIA (Thor Boosted) portion of the program. This redirection has eliminated the requirement for development of a system suitable to the recovery of photographic film from an orbiting vehicle and replaced it with the need for developing a modified recovery technique appropriate to the support of the aeromedical explorations to be conducted in consonance with the new secondary objectives of the program.

2. Prior to the redirection of Ref. (1) a division of responsibility between prime and subcontractor had been established and a work plan approved by the USAF for accomplishment of the film recovery program. The change in the recovery aspect of the program has required a redetermination of responsibilities for the prime and subcontractors in accomplishing the redirected work and has been defined by LMSD, based on discussion with members of the USAF, as follows: LMSD will assume over-all system responsibility for all biosatellite flights incorporated into the flight program. As weapon system contractor LMSD will determine the general specifications for the subsystem, the general manner in which the subsystem will be developed, the integration of the subsystem into the program, and will select for approval of USAF subcontractors to be used. Supporting studies and developmental investigations will be made as necessary to establish technical validity of design and feasibility of intended flights. All phases of the program attendant to the operational recovery are considered the responsibility of LMSD. It is intended to augment the capability of LMSD by the use of subcon-

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

~~CONFIDENTIAL~~

EXHIBIT-G

tractors so as to permit the most expeditious achievement of the program. Subcontractor efforts will be:

- (a) Design and construction of the re-entry shell.
- (b) Design and construction of the biosatellite sealed capsule including all necessary environment control and life-support components.
- (c) Experimental animals and training as approved by the Air Force.
- (d) Biomedical data sensors, processors, and on-board recorders as approved by the Air Force.
- (e) Design and construction of recovery devices on or in the biomedical capsule.
- (f) Test program for proving satisfactory performance of the biomedical capsule.
- (g) Design and construction of ground support trailers for biomedical capsule.

3. The weapon system contractor recognizes General Electric's paramount position in this field and concurs with the Air Force direction that General Electric be made sole source subcontractor to assist in accomplishment of tasks (a) through (f) listed above. A separate subcontract will be established for accomplishment of task (g).

4. It has been requested by the USAF (meeting at LMSD between representatives of AFBMD, HDRME, and LMSD) that the aeromedical payload be included in the 2nd flight of the IIA (Thor Booster) program scheduled for December 58. It is recommended that the incorporation of this AM payload be withheld until the 3rd flight scheduled for January 59. It is further recommended that the total number of biosatellite flights be five with a possible sixth with a flight position as shown by the following schedule.

This recommendation is based on the indication by USAF that Thor boosted flights in addition to the ten presently programmed will be required to complete the USAF objectives and therefore would permit later scheduling of biosatellite flights. This will permit better utilization of the early flights in the accomplishment of the program's primary objectives, namely "proof of the basic 117L vehicle". The schedule proposed would be as follows:

Flight	1	2	3	4	5	6	7	8	9	10
Month	11/58	12/58	1/59	2/59	3/59	4/59	5/59	6/59	7/59	8/59
Obj.	117L	117L	AM	117L	117L	AM or 117L	AM	AM	AM	AM
Engine Fuel	(- - - - -JP4- - - - - -)					(- - - - - - - -UDMH- - - - - - - - - -)				

~~CONFIDENTIAL~~ SECRET

5. On the basis of previous discussions with members of AFBMD and on the assumption of your concurrence, LMSD is proceeding to establish subcontracts in accord with the definition of responsibilities as stated above. Early approva of the schedule shown herein is requested to permit its immediate incorporation into the program.

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION

J. H. Carter, Manager
XA Weapon System Branch

JHC:FWO'G:sg

cc: Deputy Air Force Plant Representative
Sunnyvale, California

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~ SECRET

COORDINATION SHEET

R+D 7/8

OFFICE OF ORIGIN WILL ENTER OFFICE SYMBOLS IN THE "TO" BLOCKS IN ORDER OF DESIRED COORDINATION

PERSON COORDINATING WILL ENTER NAME AND DATE IN APPROPRIATE BLOCK

TO:	
NAME:	
DATE:	
TO:	
NAME:	
DATE:	
TO:	
NAME:	
DATE:	
TO:	
NAME:	
DATE:	
TO:	
NAME:	
DATE:	
TO:	MCPTA
NAME:	CUV
DATE:	Aug 58
TO:	WDBSF
NAME:	[illegible]
DATE:	28 Aug 58
TO:	
NAME:	27 Aug
DATE:	[illegible]

WDDSR

SEP 4 1958

SUBJECT: Contract 04(644)-181, Internal Air Force Responsibilities Concerning Biosatellite Programs.

TO: Lockheed Aircraft Corporation
Missile Systems Division
ATTN: Mr. J. E. Carter
3251 Hanover Street
Palo Alto, California

DOWNGRADED AT 3 YEAR INTERV
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

1. The following Air Force internal agreements concerning the Biosatellite Program technical responsibilities to be assigned to the School of Aviation Medicine and the Bioastronautics Division are furnished for your information and guidance.

a. The Bioastronautics Division (BAD) has been given managerial responsibility for all animal biosatellite programs and will act as technical director to the contractor on biomedical aspects.

b. Biomedical consultation will be provided to the maximum by in-Air Force consultants. Use of non-Air Force biomedical consultation will be held to an absolute minimum and use of such consultants, when necessary, will be approved by Air Force.

c. The School of Aviation Medicine will provide to the contractor, via the Bioastronautics Division, environmental standards, biomedical objectives and limits, experimental design, data to be collected and technical approaches to be used. However, if these criteria cannot be provided in time to meet the contractor's deadlines, BAD will initiate action to secure such criteria from other available sources.

d. The School of Aviation Medicine will consult on biomedical test programs and evaluate biomedical test results.

e. The School of Aviation Medicine will provide continuous biophysical and biomedical technical standards, liaison and consultation to the contractor as these are related to the biomedical success of the experiment. Any changes resulting from this liaison which would affect cost or time expended by contractor must receive prior approval by BAD through BMD/BMO.

This [illegible] contains information affecting the National Defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Section [illegible] the revelation of its [illegible]

OFFICE OF ORIGIN: WDTRE

TYPIST

DICTATOR

PHONE NO.

OFFICIAL FILE COPY

SECRET

PERMAN

Copy 1 of 2

DATE OF DISPOSITION

OFFICE OF ORIGIN WILL ENTER OFFICE SYMBOLS IN THE ... BLOCKS IN ORDER OF DESIRED COORDINATION

PERSON COORDINATING WILL ENTER NAME AND DATE IN APPROPRIATE BLOCK

WDTSL/BAD
BW Kam 1Lt
Sept 58

COORDINATION SHEET

f. Direct contact is authorized between BAD and contractor; information copies will be provided to BAD and WDD.

2. The above does not change the fact that the WS 117L Project Office [illegible] - [illegible] has responsibility for non-medical aspects of Subsystem E and is Lockheed's official contact point with the Air Force.

SIGNED

FREDERIC C. E. ODER
Colonel, USAF
Director for WS 117L

Copies furnished:
AFPR, LMSD
ATTN: Mr. J. McLachlin
Sunnyvale, California

WDTSL/BAD

This document contains information affecting the National Defense of the United States within the meaning of the Espionage Law, Title 18, U.S.C., Section 793 and 794. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

~~CONFIDENTIAL~~

SECRET

WDTSR 58-129
Cy 9 of 9

OFFICE OF ORIGIN: WDTSRE	TYPIST: lkg - 28 Aug	OFFICIAL FILE COPY WDTSR Office of Record	TEMPORARY ☐
DICTATOR: Capt Johnson	PHONE NO: 2594		DATE OF DISPOSITION

1 sheet

[redacted]

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECTIONS 793 AND 794, ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

CONFIDENTIAL

ATE	FACILITY	DURATION	COMPONENT FAILURE	USE	REMARKS
/1/59	BEMCO	5 1/2 Hrs.	O_2 Regulator	96	Component Failure - Test aborted to save animal
/4/59	BEMCO	30 Hrs.	Air Con.	96	Animal died - A/C did not function - R. H. & Temp too high G. E. (After Failure) stated A/C would not functio vertical position. No mention of this limitation by G. E. Rep. at time of test.
4/59	HADC	23 Hrs.	L/C Leaks & Air Cond.	133	Animal died - A/C did not function even tho unit was horizontal - Cooler external test line froze L/C Temp too high
16/59	SAM	27 Hrs	O_2 Reg.	133	O_2 Reg. bypassed after failure, no alt. or temp. simulation - animal survived
13/59	HADC	28 Hrs.	None	133	Sled Run - no failures
22/59	HADC	36 Hrs.	None	133	Alt. Chamber - no failures
30/59	HADC	24 Hrs.	Air Cond. L/C Leaks	133	Animal died - L/C temp. too high & CO_2 too high - Fan Opn on 18v not adequate
3/59	WPAFB	24 Hrs.	None	133	Centrifuge Test - no failures

SUMMARY OF LIFE CELL SYSTEM TESTS WITH ANIMAL (CONT'D)

E	FACILITY	DURATION	COMPONENT FAILURE	USE	REMARKS
0/59	NADC	22 Hrs.	'O' Ring & Tygon Tubing	152	Test aborted to save animal - Alt. Chamber - Lost L/C Press. - 'O' Ring & Tygon Tubing leaks
15/59	NADC	19 Hrs.	B/B Valve Leak	152	Animal Died - Alt. Chamber - nitrogen build up due to failure to purge after air valve leak repair
24/59	NADC	25 Hrs.	None	133	Sled Run - No Failures
1/59	VAFB	21 Hrs.	Pyroswitch O_2 Reg.	152	Alt. Chamber - Test aborted to save animal - Comp. Press low - Pyroswitch blew on Instln. Partially switching over to recovery mode
25/59	BEMCO	21 Hrs.	Air Cond. Sintered Plates	15	Alt. Chamber - Test aborted to save animal - CO_2 & R. H. very high - EKG did not read out

(2) Ground support equipment and other unique requireme logical specimens.

(3) Behavior conditioning and performance measuring req

b. USAF School of Aviation Medicine

Recommendations concerning instrumentation of the biolo

c. Aeromedical Field Laboratory (AFMDC)

Procurement, physical conditioning, maintenance, surfac animals, and post-mission biological studies.

5. Previous instructions in conflict with the above can be cor seded and no longer applicable to the biomedical program.

John R.V. Di

JOHN R. V. DICKSON
Colonel, USAF
Asst Deputy Commander

5 Incls
1. Cy ltr to WADC, subj as above
2. Cy ltr to AFMDC subj as above
3. Cy ltr to AFCRC subj as above
4. Cy ltr to Air Univ subj as above
5. Cy ltr to AFOSR subj: Announcement of Desig & Org of Off Sp Asst for Bio-Astr to D/C for Ballistic Missiles, ARDC

HEADQUARTERS
AIR RESEARCH & DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
ANDREWS AIR FORCE BASE
WASHINGTON 25, D. C.

RDTHA 6 [illegible] 1958

SUBJECT: Biomedical Aspects of the Ballistic Missile Program

TO: Commander
Air University
Maxwell Air Force Base, Alabama

1. Special Orders Number A-920, Department of the Air Force, 9 May 1958, assigned Brigadier General Donald D. Flickinger, Staff Surgeon and Director of Human Factors, Headquarters ARDC, as an additional duty, Special Assistant for Bio-Astronautics to the Deputy Commander for Ballistic Missiles, ARDC.

2. All research and development efforts, contemplating the use of biological payloads on board missiles or space vehicles, will obtain the coordination and approval of the Special Assistant for Bio-Astronautics or his designated representative.

3. To provide the Ballistic Missile Division with timely life sciences support in the coordination of procurement data, monitorship of contractor efforts, and supervision of inspection tests of components of life supporting and bio-performance measuring equipment, technically qualified life sciences personnel will be placed on TDY or will be assigned to the Ballistic Missile Division. These personnel will be authorized to render decisions regarding the adequacy of life supporting equipment and other technical problems concerned with viable payloads. This headquarters, ATTN: RDTH, will be informed of all decisions in this area. In addition, a monthly progress report on the development, fabrication, testing, and scheduling of the life sciences portion of the program will be provided.

4. A significant portion of the nation's life sciences capability in support of space operations is contained in certain Air Force medical and behavioral sciences research and development organizations. Certain of these agencies are hereby designated as points of contact for the weapons systems management organization and contractors concerned with development and fabrication of life supporting equipment and life sciences experiments. The designation of these units is for the primary purpose of assuring that the contractor has the latest information available for incorporation into his design, and secondly, to assure the fabricated unit meets the technical criteria as established by the Air Force. The bio-astronautical members of the Ballistic Missile Division will obtain

over-all approval and coordination of the life sciences aspect of the project. But, in so doing, will consult freely and frequently with the designated units, assuring that liaison is being maintained with the prime contractor and subcontractors on the technical biomedical and bio-performance problems associated with the projects.

a. Aeromedical Laboratory (WADC)

(1) Determination of the biological adequacy of subassemblies, technical specifications for the internal life support environment, and the normal technical development program responsibilities of the laboratory for such environments.

(2) Ground support equipment and other unique requirements for biological specimens.

(3) Behavior conditioning and performance measuring requirements.

b. USAF School of Aviation Medicine

Recommendations concerning instrumentation of the biological subjects.

c. Aeromedical Field Laboratory (AFMDC)

Procurement, physical conditioning, maintenance, surface recovery of animals, and post-mission biological studies.

5. Previous instructions in conflict with this letter can be considered superseded and no longer applicable to the biomedical program.

6. Your concurrence with the provisions of paragraph 4, above, is requested.

FOR THE COMMANDER:

JOHN R. V. DICKSON
Colonel, USAF
Asst Deputy Commander/R&D

1 Incl
Cy ltr to AFOSR
fr ARDC RDTHA

HEADQUARTERS
AIR RESEARCH & DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
AND[illegible] SE

RDTHA 6 JUN 1958

SUBJECT: Announcement of Designation and Organization of Office of Special Assistant for Bio-Astronautics to Deputy Commander for Ballistic Missiles, ARDC

TO: Commander
Air Force Office of Scientific Research
Washington 25, D. C.

1. Reference is made to Paragraph II, General Order Number 18, this headquarters, dated 22 May 1958, subject as above.

2. The Special Assistant for Bio-Astronautics, Ballistic Missiles Division, or his designated representative, will assume final technical coordination responsibility for all biological payloads placed on board ballistic missiles and space vehicles. In order that all bio-medical and behavioral science experiments and tests be known and appropriately coordinated and integrated with the Ballistic Missiles Program, it is requested that any research projects under the cognizance of your office, such as "Piggy Back," contemplating biological payloads be coordinated with the above office.

FOR THE COMMANDER:

JOHN R. V. DICKSON
Colonel, USAF
Asst Deputy Commander/R&D

[illegible]

HEADQUARTERS
AIR RESEARCH ~~AND DEVELOPMENT~~ COMMAND
UNITED STATES AIR FORCE
Andrews Air Force Base
Washington 25, D. C.

ADDRESS REPLY TO
COMMANDER, ARDC, ATTN
RDTH

12 August 1958

SUBJECT: Responsibilities of School of Aviation Medicine in the ARDC Biosatellite Program, Subsystem L WS-117L

TO: Commander
Air University
Maxwell Air Force Base
Alabama

1. Pursuant to the directive of the Commander, Air Research and Development Command that all USAF biomedical resources be used in support of subject program, agreements have been reached between representatives of Headquarters Air Research and Development Command, Headquarters United States Air Force, Air University (Headquarters School of Aviation Medicine), Air Force Missile Development Center, and Wright Air Development Center, concerning technical responsibilities to be assigned to the School of Aviation Medicine.

2. As the result of the meeting referenced in paragraph 1, the inclosed statement of policy is hereby published as Supplement No. 1 to the letter from this headquarters, RDTHA, dated 6 June 1958, subject: Biomedical Aspects of the Ballistic Missile Program. Provisions of paragraph 4, referenced letter, in conflict with policy letter for subsystem L, will be disregarded.

FOR THE COMMANDER:

[illegible] J. WASSELL
[illegible]
[illegible]
[illegible]

1 Incl
Supplement No. 1, Hq ARDC
Letter, 6 Jun 1958, subj:
Biomed Aspects of Ballistic
Missile Program, 8 Aug 1958
(S)

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

[illegible]

EXHIBIT L-[illegible] 43
[illegible] 1, 2.

COPY

8 August 1958

SUPPLEMENT NO. 1 TO HQ AIR RESEARCH AND DEVELOPMENT COMMAND LETTER RDTHA, DATED 6 JUNE 1958, SUBJECT: BIOMEDICAL ASPECTS OF THE BALLISTIC MISSILE PROGRAM

1. Policy:

1.1 The United States Air Force is responsible for establishment of biomedical criteria for subsystem L capsules and specimens. The managerial responsibility for all animal biosatellite programs rests within the Bioastronautics Division (BAD), Air Force Ballistic Missile Division, Hq ARDC. The United States Air Force will specify environmental standards, biomedical objectives and limits, experimental design, data to be collected and technical approaches to be used.

1.2 Biomedical consultation will be provided to the maximum by in-Air Force consultants. Use of non-Air Force biomedical consultation will be held to an absolute minimum and use of such consultants, when necessary, will be approved by Air Force.

1.3 Air Force will act as technical director to the contractor on biomedical aspects.

2. Function:

2.1 The School of Aviation Medicine will provide to the contractor, via the Bioastronautics Division, criteria noted in paragraph 1.1, above.

2.2 The School of Aviation Medicine will consult on biomedical test programs and evaluate biomedical test results.

2.3 The School of Aviation Medicine will provide continuous biophysical and biomedical technical standards, liaison and consultation to the contractor as these are related to the biomedical success of the experiment. Any changes resulting from this liaison which would affect cost or time expended by contractor must receive prior approval by BAD.

2.4 All other decisions relative to test responsibility and conduct engineering requirements, scheduling, time and costing functions and general welfare of the program will remain with BAD or their properly designated representatives, and BAD decisions are final.

2.5 Whereas contractor costs will be supported by AFBMD (Hq ARDC), those costs and manpower requirements such as TDY, materials, transportation, labor and parts, incurred by the School of Aviation Medicine in the implementation of this policy will be borne by the School of Aviation Medicine, Air University.

C8-61,173

2.6 This policy becomes effective immediately. If the requirement for criteria referred to in paragraph 2.1 cannot be provided in time to meet contractors' deadlines, BAD will initiate action to secure such criteria from other available sources.

2.7 Direct contact is authorized between SAM and contractor; information copies will be provided to BAD.

DON FLICKINGER
Brigadier General, USAF (MC)
Director of Life Sciences

FUNCTIONAL STATEMENT

DIRECTORATE, DISCOVERER SATELLITE SYSTEM (WDZSD), OFFICE OF THE ASSISTANT DEPUTY COMMANDER, SPACE SYSTEMS

1. Responsible to the Assistant Deputy Commander, Space Systems, for the integration of all research, development, and test aspects of the Discoverer Satellite System. Responsible for the determination of detailed performance specifications, pertinent physical characteristics, and essential functional criteria necessary to meet developmental or operational requirements. Monitors and/or co-ordinates the actions of all other participating AFBMD agencies in the preparation of detailed preliminary planning data, the production of development plans, and the formulation of work statements essential to the integration of all elements of the Discoverer Satellite System, to respond to specific Department of Defense and Air Force directives and requirements pertaining to the Discoverer System. Develops and maintains a closely co-ordinated time schedule for all directorate activity to insure that orderly progress in the system is maintained, and to permit the most effective expenditure of resources by identifying those areas which require timely attention. Evaluates contractor proposals as appropriate. Prepares and forwards reports as required. Directs and co-ordinates all AFBMD and contractor activities as appropriate for and pertaining to the development and test of the Discoverer System to insure the orderly and timely achievement of an operationally suitable and reliable system.

2. Co-ordinates the actions of all agencies participating in and supporting the development and test of the Discoverer System, including the AFBMD, ARDC Centers, other AF Command, U. S. Navy, and U. S. Army.

EXHIBIT M

COORDINATION SHEET

TYPIST INITIALS		
aenc 26 Oct 59	PERMANENT	
	TEMPORARY	

WDZS/Col Oder/1522

Management of DISCOVERER Biomedical Program

OCT 26 1959

WDZ
WDZD

1. There have been a series of memoranda from various sources on the above subject.

2. The disagreement (as to whether or not a certain test was needed) arose, I believe, largely because of misunderstanding and with those directly concerned widely scattered about the country at the time the matter came up.

3. Generally speaking, in the subject program WDZPB serves as a subsystem manager supporting WDZSD. The arrangement has worked fairly well until the item cited in par 2 arose, and will, I believe continue to be effective.

4. While this current problem has been resolved, I must as a matter of policy support the view that the Director, DISCOVERER Satellite System is basically responsible for the quality of all aspects of the DISCOVERER Program and, accordingly, must have the authority which is required to meet the responsibility assigned to him.

SIGNED

FREDERIC C. E. ODER
Colonel, USAF
Assistant Deputy Commander
Space Systems

Copy to:
WDZSD
WDZPB
WDZA

EXHIBIT N

NATOR COORDINATION					
AT					

JUN 58 11

VERBATIM TESTIMONY TO BE provided

[redacted]

[redacted]

SEE DOCUMENT NO 167
for original

APPENDIX B

This Launch Data Digest was Appendix D of several Lockheed Aircraft Corporation reports, but they reflect corrections made by Space and Missile Systems Organization's Historian, and the addition of information on the two last launches.

CLASSIFICATION OF THIS DOCUMENT
WILL BE DOWN GRADED TO Uncl
UPON REMOVAL OF ENCLOSURES.

APPENDIX D LAUNCH DATA DIGEST

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
System Test Report	1019/160	4	1-21-59	No	Simulated capsule		Malfunction during countdown caused ullage rockets, retro-rockets, separation bolts, and horizon scanner fairing to fire when hydraulic motor was turned on. Design problem. Launch was aborted.	
1 220053	1022/163	4	2-28-59 1349:16 PST	Probable (not confirmed)	Simulated capsule (recovery not programmed)	Hydraulic motor circuit separated from pyrotechnics circuit.	Injection angle - 1.7 deg, partially attributable to erratic hydraulic control at engine ignition. No telemetry or radar orbital contacts made. Questionable radio and radar contacts reported.	Azimuth: 182.8 deg Altitude: 184 nm Velocity: 25,600 fps ESTIMATED: Inclination: 89.96 deg Eccentricity: 0.046 Period: 96 min Perigee: 99.3 nm Apogee: 605 nm
2 220089	1018/170	4	4-13-59 1318:42 PST	Yes	Biomedical research (BRC). No	UDMH fuel incorporated. Horizon scanner active during engine burning phase, and gains altered to tighten control system.	Premature S-01 engine shutdown by command - source unknown, but believed resulting from a main power relay malfunction. Orbit achieved, but inadvertent 55/R reset command caused loss of recovery timing. Capsule ejected with re-entry over Spitsbergen.	Azimuth: 182.8 deg Altitude: 167.2 nm Velocity: 25,542 fps Inclination: 90 deg Eccentricity: 0.007 Period: 89.7 min Perigee: 150 nm Apogee: 736 nm
3 220139	1020/174	4	6-3-59 ~~6-4-59~~ 1309:21 PDT	No	BRC - (Live payload)	Fairchild Timer incorporated.	Premature S-01 engine shutdown from either propellant interruption or exhaustion prevented vehicle reaching orbital velocity. Indicated cause - vortexing or sloshing of oxidizer within tank.	Azimuth: 182.8 deg Altitude: 165 nm Velocity: 24,950 fps
4 220165	1023/179	5	6-25-59 1547:46 PDT	No	Advanced engineering test (AET)	None.	Within tolerance but below nominal SLV-2 and S-01 engine performance; increased S-01 payload to propellant ratio; and premature engine shutdown combined to prevent reaching orbital velocity. Integrator output incorrect. Umbilical mast failed to retract.	Azimuth: 177.3 deg (175 deg nom) Altitude: 102 nm Velocity: 25,000 fps
5 220210	1029/190	4	8-13-59 1200:08 PDT	Yes	AET. No	Vehicle and payload weight reduced. Fuel slosh screens removed. Vortex suppressor installed. Propellant capacity increased. AJ-1 fuel substituted [illegible]. Delta V increased to yield elliptical orbit and longer period.	Burnout due to propellant exhaustion. High propellant utilization. Capsule ejected but not recovered. Recovery sequence believed not accomplished due to extreme cold effects on Mercury battery. Capsule in orbit.	Azimuth: 169.8 deg Altitude: 138 nm Velocity: 25,890 fps Inclination: 87 deg Eccentricity: 0.0407 Period: 94.18 min Perigee: 136 nm Apogee: 480 nm
6 220214	1028/200	5	8-19-59 1224:44 PDT	Yes	AET. No	Paint removed from nose cap area to improve capsule thermal characteristics. Weight further reduced by 13 lbs.	Integrator output low. Burnout resulted from propellant exhaustion. Transients during separation. SLV-2 roll program set for incorrect azimuth heading. Capsule ejected but not recovered. Recovery sequence again believed not accomplished.	Azimuth: 175.8 deg (170 deg nom) Altitude: 140 nm Velocity: 25,985 fps Inclination: 85 deg Eccentricity: 0.0468 Period: 95.27 min Perigee: 137.2 nm Apogee: 533.9 nm
7 445936-51	1051/206	4	11-7-59 1228:41 PST	Yes	AET. No.	Approximates FTV-1028, except as follows: horizon scanner installed with deeper depression angle (15.8 deg) to allow better control at apogee. Modified capsule, i.e., telemetry installed; redesigned coupling between ablative shell and capsule; more reliable batteries; and thermostat for batteries. Sun position indicator device and instrumentation gyro installed to provide attitude data.	Separation slow. S-01 propulsion and guidance satisfactory. After loss of telemetry 400-cycle power failed causing vehicle tumbling. Nitrogen supply gas exhausted prior to orbit 2 contact by Kodiak Station. Capsule could not be ejected.	Azimuth: 172 deg Altitude: 105 nm Velocity: 26,115 fps Inclination: 81.6 deg Eccentricity: 0.049 Period: 94.46 min Perigee: 102 nm Apogee: 525 nm
8 445936-50	1050/212	5	11-20-59 1125:24 PST	Yes	AET. No.	Similar to FTV-1051 with the exception that a sensing circuit has been added to the 400-cps output in order to detect excessive overloads and/or inverter failure.	Accelerometer malfunction resulted in excessive velocity and eccentric orbit. S-01 engine operated to propellant exhaustion. Erratic attitude during ullage rocket firing. Umbilical release defective. Apogee beyond horizon scanner capability. Extended period required capsule ejection on orbit 15. No beacon for recovery.	Azimuth: 172 deg Altitude: 120 nm Velocity: 26,890 fps Inclination: 80.8 deg Eccentricity: 0.108 Period: 103.7 min Perigee: 115.2 nm Apogee: 1043 nm
9 445936-52	1052/218	4	2-4-60 1051:45 PST	No	AET.	Similar to FTV-1050 with the exception of the following: a. APL Doppler acquisition transition transmitter added. b. Two lights (Baker-Nunn) added for ground acquisition. c. Control gas mixture changed to provide total impulse of 3050 lb/sec instead of 1800 lb/sec.	Umbilical mast failed to retract. Helium coupler tore from S-01; He. supply pressure lost. SLV-2, with MECO occurring 20 sec early, failed to reach boost velocity. S-01 pitch actuator malfunction resulted in vehicle tumbling. Excessive g loads caused S-01 engine cutoff at 15.6 sec. Impact occurred about 400 nm down-range.	Azimuth: 173 deg
10 445936-54	1054/223	5	2-19-60 1215:14 PST	No	AET.	Similar to FTV-1052	A malfunction occurred in the SLV-2 pitch control loop, causing the S-01 vehicle to enter into a divergent pitch oscillation immediately after liftoff. The oscillation caused the vehicle trajectory to deviate. The vehicle was destroyed by Missile Flight Safety after 56 sec of flight	Azimuth: 182 deg (172 deg intended)

Downgraded at 12-Year Intervals; Not Automatically Declassified, DoD Dir 5200.10

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18 U.S.C., Sec. 793 and 794. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

APPENDIX D LAUNCH DATA DIGEST (Continued)

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
11 445936-55	1055/234	5	4-15-60 1230:37 PST	Yes	AST. No	Similar to FTV-1052	Liftoff and SLV-2 boost normal. S-01 engine cutoff premature due to error in calibration of command-4 integrator scale factor. The resulting approximately 1 min shorter than planned period did not affect recovery. Horizon-scanner transients during orbit. Failure to recover capsule attributed to spin deficiency.	Azimuth: 172 deg Altitude: 108.7 nm Velocity: 26,015 fps Inclination: 80.37 deg Eccentricity: 0.037 Period: 92 min Perigee: 106.0 nm Apogee: 379.3 nm
12 445936-53	1053/160	5	6-29-60 1520:44 PST	No	Diagnostic. No	Similar to FTV-1052	Orbital injection not achieved due to an erratic horizon-scanner output. As a result, negative flight path angle caused the S-01 to re-enter the atmosphere. SLV-2 boost somewhat low in velocity and altitude. From 150 to 162 sec, 22-cps SLV-2 oscillations occurred. A moment on the S-01 after burnout indicated blocking of one oxidizer vent nullifier outlet.	Azimuth: 171.7 deg Altitude(max): 127.7 nm Altitude(BO): 104.7 nm Injection Angle: -7 deg
13 445936-57	1057/231	5	8-10-60 1337:54 PDT	Yes	Diagnostic. Yes-first capsule recovery. Recovery made by helicopter at sea.	Vehicle weight reduced for heavier payload. AST equipment, AFL beacon, and optical tracking lights removed. Horizon scanner modified to reduce transient susceptibility. Gas jet system replaced spin rockets on payload.	Successful liftoff achieved on first countdown. Boost altitude high but within tolerance. SLV-2 pitch plane oscillations after 134 sec attributed to pitch-rate feedback loop. A similar but lesser amount than with S-01 1053 (oxidizer vent nullifier problem) noted. All systems performed to launch, boost, and inject the S-01 into near polar orbit under controlled attitude and in a condition suitable to effect recovery.	Azimuth: 174 deg Altitude: 160.2 nm Velocity: 25,706 fps Inclination: 82.87 deg Eccentricity: .0326 Period: 94.1 min Perigee: 157.7 nm Apogee: 436.1 nm
14 445936-56	1056/237	4	8-18-60 1257:07 PDT	Yes	AST. Yes - first successful air recovery.	AFL beacon and optical tracking lights restored. Continued use of gas jet spin system on payload.	Liftoff on first countdown. Ascent trajectories, and injection velocity within specifications. Indicated attitude instability during orbital passes 1 and 2. Satellite stabilized by pass 8, sharply reducing control gas consumption. Capsule recovered [illegible] downrange from predicted impact area by C-119 aircraft.	Azimuth: 172.4 deg Altitude: 120.4 nm Velocity: 26,126 fps Inclination: 79.63 deg Eccentricity: 0.046 Period: 94.54 min Perigee: 119.1 nm Apogee: 507.5 nm
15 445936-58	1058/246	5	9-13-60 1513:39 PDT	Yes	AST. No	Similar to FTV-1056	Launch successful on first countdown. Liftoff abnormal in that S-01 umbilicals ejected before actual liftoff. SLV-2 boost normal. SLV-2 oscillation noted. Momentary drop in thrust following S-01 engine ignition. Pneumatic attitude control system (gas jet) malfunction depleted control gas before recovery pass. Capsule located about 960 nm southeast of predicted impact point. Squall prevented sea recovery before capsule sank.	Azimuth: 175 deg Altitude: 131.4 nm Velocity: 26,015 fps Inclination: 80.91 deg Period: 94.2 min Perigee: 131.4 nm Apogee: 478.7 nm
16 445936-61	1061/253	4	10-26-60 1234:09 PST	No	AST	First S-01 (Model 4605)	Launch on second attempt. Inoperative D-timer prevented programming of S-01 functions. No separation: combined vehicle followed ballistic trajectory after SLV-2 burnout. SLV-2 vernier and main engines cut off nearly simultaneously. SLV-2 structural oscillations during final 13 sec of boost.	
17 445936-62	1062/297	5	11-12-60 1242:32 PST	Yes	AST. Yes - air recovery	Similar to 1061 (S-01)	Satisfactory launch after initial cancellation on previous day due to umbilical connector J-933 (D-timer) being separated from S-01 when the transporter-erector was lowered. All systems performed to launch, boost, and inject the S-01 into near-polar orbit under controlled attitude and in a condition suitable to effect recovery. Capsule recovery by aircraft at predicted point of descent. S-01 longitudinal oscillations prior to MECO similar to missiles 160, 246, and 253.	Azimuth: 172 deg Altitude: 118 nm Velocity: 26,270 fps Inclination: 81.8 deg Eccentricity. 0.058 Period: 96.45 min Perigee: 116.5 nm Apogee: 616.1 nm
18 445936-63	1103/296	4	12-7-60 1220:59 PST	Yes	AST. Yes - air recovery	S-01 with 8096 engine (dual start - not used on this launch). SLV-2 Block-2 engine (165,000-lb thrust) used for first time with S-01 vehicle.	Launch on first attempt. Liftoff and SLV-2 boost normal. Higher amplitude longitudinal oscillations (3.5 g) than with previous vehicles. All S-01 functions effected. Orbit close to that desired. Aerial capsule recovery after 48 passes (3 days), the longest time in orbit before initiating recovery.	Azimuth: 172 deg Altitude: 156.9 nm Velocity: 25,860 Inclination: 81.49 deg Eccentricity: 0.0367 Period: 93.67 min Perigee: 152.8 nm Apogee: 437.3 nm

APPENDIX D LAUNCH DATA DIGEST (Continued)

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
19 445936-01	1101/258	5	12-20-60 1236:51 PST	Yes	Radiometer RM-1 nonrecoverable capsule.	S-01 with 8081 engine. SLV-2 with Block-1 engine.	Launch on second attempt. Liftoff and SLV-2 boost normal. All S-01 functions effected. Orbital boost satisfactory to obtain orbital status. Attitude control lost after orbital injection because of depletion of control gas, apparently due to a malfunction in the gas valve control amplifier.	Azimuth: 172 deg Altitude: 136.2 nm Velocity: 25,850 fps Inclination: 83.5 deg Eccentricity: 0.033 Period: 92.9 min Perigee: 133.5 nm Apogee: 400.5 nm
20 445936-04	1104/298	4	2-17-61 1225:08 PST	Yes	ARP. No	S-01 with 8096 engine (dual start not used). SLV-2 Block 2 engine (165,000-lb thrust). Open loop test of BTL guidance system. Scheduled 4-day active orbital life.	Launch on second attempt. Liftoff, SLV-2 boost, and S-01 boost satisfactory to attain orbit but S-01 guidance difficulties during boost and intermittent on orbit. SLV-2 17-21 cps longitudinal oscillations of about 1.5 g's prior to MECO. Orbital timer malfunction on pass 31 precluded recovery attempt.	Azimuth: 172 deg Altitude: 203.5 nm Velocity: 25,690 fps Inclination: 80.91 deg Eccentricity: 0.0366 Period: 95.31 min Perigee: 186 nm Apogee: 501 nm
21 445936-02	1102/262	5	2-18-61 1157:58.1 PST	Yes	Nonrecoverable radiometer.	S-01 with 8096 engine equipped and programmed for first dual start.	Launched on first attempt. Liftoff and boost phase normal although oscillations were noted in accelerometer and booster propellant pressure data. Coast phase and orbital stage boost phase normal except for excess velocity gain. Orbit period and eccentricity were high as a result of the high injection velocity. Engine restart and operation for 1 sec during first pass was accomplished.	Azimuth: 171.6 deg Altitude: 127.3 nm Velocity: 26,010 fps Inclination: 80.7 deg after first burn 80.7 deg after second burn Eccentricity: .0383 after first burn .0389 after second burn Period: 93.9 min after first burn 97.8 min after second burn Perigee: 159 nm after second burn Apogee: 670 nm after second burn
22 445936-05	1105/300	4	3-30-61 1234:43 PST	No	ARP	S-01 with 8096 engine (dual start not used). SLV-2 with Block 2 engine and BTL guidance.	Launch on first attempt. Liftoff and SLV-2 boost normal. BTL guidance actively used for the first time, successfully computed and transmitted SLV-2 steering and sequence commands and discretes for S-01 engine start and velocity gain. Orbit not attained due to control system malfunction - loss of hydraulic pressure approximately 20 sec prior to engine shutdown. Resulting loss of attitude control caused erroneous injection velocity vector and possibly low injection velocity due to premature engine shutdown.	Azimuth: 172 deg
23 445936-06	1106/307	5	4-8-61 1121:08 PST	Yes	ARP. No	Similar to 22	Launch on first attempt. Liftoff, SLV-2 boost, and S-01 orbital injection were normal. Added instrumentation indicated that stress on S-01 from 20-cps SLV-2 oscillations is less severe than previously calculated. Between pass 6 and pass 7 the horizon scanner failed; between pass 9 and pass 10 control gas was suddenly lost. Capsule re-entry was not effected due to vehicle tumbling.	Azimuth: 172 deg Altitude: 189.6 nm Velocity: 25,640 fps Inclination: 82.3 deg Eccentricity: 0.034 Period: 96.1 min Perigee: 185.5 nm Apogee: 436.6 nm
24 445936-08	1108/308	4	6-8-61 1416:08 PST	No.	ARP	Similar to 22	Launch on first attempt. S-01 transient voltage dropout just prior to liftoff, clearing with umbilical J-100 release. SLV-2 boost and guidance normal. During boost, S-01 aft section registered excessive heating starting at T+20 sec, indicating small fire; voltage transient dropout occurred from T+77.5 to T+87.3 sec and T+137 to T+144 sec; at T+144 sec, telemetry was lost. Failure of the electrical power system, probably as a result of fire, prevented normal functioning of S-01 sub-systems, precluding orbital injection.	Azimuth: 172 deg
25 445936-07	1107/303	1	6-16-61 1607:52 PST	Yes	ARP. Yes - sea recovery	S-01. SLV-2 DM21 with Block 2 main engine, Block 1 vernier engines.	Launch on first attempt and first launch from complex 75-1, recently modified to SLV-2/S-01 configuration. Technical hold, 88.16 min. Liftoff normal. SLV-2 executed longest roll program to date: 87 deg 30 min. Error in first step of pitch program corrected by command guidance after steering commands initiated. All S-01 sub-systems operated properly to establish a near-nominal orbit. Capsule ejection on 33rd pass.	Azimuth: 172 deg Altitude: 148 nm Velocity: 25,645 fps Inclination: 82.1 deg Eccentricity: 0.014 Period: 90.87 min Perigee: 140 nm Apogee: 256 nm

APPENDIX D LAUNCH DATA DIGEST (Continued)

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
26 445936-09	1109/308	5	7-7-61 1629:48 PDT	Yes	AST. Yes - air recovery	Similar to 25	Launch on first attempt. SLV-2 thrust greater than predicted after slow engine start sequence. S-01 coupling P-100 appeared to hang up on the vehicle at umbilical release with corresponding drop in battery-bus and regulated ±28V power. Greater S-01 eccentricity and orbital period attributed to integrator error.	Azimuth: 172 deg Altitude: 146.8 nm Velocity: 26,000 fps Inclination: 82.96 deg Eccentricity: 0.042 Period: 95 min Perigee: 146.2 nm Apogee: 504.4 nm
27 445936-10	1110/302	4	7-21-61 1535:00.46 PDT	No	AST	Similar to 25	Liftoff on first attempt. Immediately after liftoff, a malfunction in the autopilot caused the vehicle to enter into divergent pitch accelerations. At T+59.2 sec, a -3 g moment which increased beyond calibration limit, was measured by the S-01 accelerometer, starting destruction of the vehicle. At T+60 sec, the vehicle was enveloped in flame, and at T+78.7 sec the vehicle exploded. The cause of the malfunction is attributed to an open circuit in the SLV-2 flight controller pitch-rate loop.	
28 445936-11	1111/309	1	8-3-61 1701:22 PDT	No	AST. (recoverable)- No BSP (nonrecoverable)	Similar to 25 but with SLV-2 control system modifications for improved reliability.	Launch on second attempt. Liftoff and boost, guidance and engine cutoff were normal. All S-01 systems operated satisfactorily until T+398.3 sec when loss of hydraulic pressure, possibly from a rupture on the high pressure side of the hydraulic pump, resulted in loss of pitch and yaw control and precluded orbital attainment.	
29 445936-12	1112/323	4	30 8-31-61 1900:06 PDT	Yes	AST - Yes. Sea recovery.	Similar to 26	Launch on second attempt. Liftoff, boost, and guidance normal. All S-01 systems operated to place vehicle in orbit. Hydraulic pressure T/M showed fluctuation for first 10 sec after ignition. Eccentric orbit attributed to improperly set programmable rate time program. Capsule ejection, re-entry, and recovery executed on pass 33.	Azimuth: 172 deg Altitude: 140 nm Velocity: 25,570 fps Inclination: 82.06 deg Eccentricity: .0298 Period: 91.5 min Perigee: 106.7 nm Apogee: 353.1 nm
30 445936-13	1113/310	5	9-12-61 1259:23 PDT	Yes	AST-L - Yes. Aerial recovery on pass 33.	BSP Kit 4B added.	Launch on first attempt. Liftoff, boost, and guidance normal. All S-01 systems operated to place vehicle in orbit. Potential problem resulted from a higher than predicted S-01 engine thrust level in that the required velocity gain sensed by the integrator occurred only 0.14 sec after the integrator had sent the shutdown signal before it was armed. If the integrator had sent the shutdown signal before it was armed, the engine would have burned to propellant depletion, causing excessive velocity.	Azimuth: 172 deg Altitude: 153.7 nm Velocity: 25,735 fps Inclination: 82.7 deg Eccentricity: .044 Period: 97.4 min Perigee: 150.8 nm Apogee: 345.7 nm
31 445936-14	1114/324	1	9-17-61 1600:14 PDT	Yes	AST-L - No.	BSP Kit 5B added.	Launch on first attempt. Liftoff, boost and guidance normal. All S-01 sub-systems operated to place vehicle in orbit. Capsule ejection not effected due to loss of 400-cps, 3-phase power prior to recovery pass.	Azimuth: 172 deg Altitude: 151 nm Velocity: 25,415 fps Inclination: 82.7 deg Eccentricity: .0126 Period: 90.94 min Perigee: 150.29 nm Apogee: 255.24 nm
32 445936-15	1115/328	4	10-13-61 1122:34 PDT	Yes	AST-L - Yes. Aerial recovery on pass 18.	No BSP Kit.	Launch on first attempt with but 1 min 32 sec hold time. S-01 pressurization and terminal count were run simultaneously to meet "window" requirements after an S-01 propellant transfer problem. Liftoff, boost, and orbital injection were all executed satisfactorily. Capsule re-entry and air recovery were achieved on orbital pass 18.	Azimuth: 172 deg Altitude: 148 nm Velocity: 25,649 fps Inclination: 81.63 deg Eccentricity: .0276 Period: 90.85 min Perigee: 144.5 nm Apogee: 250.9 nm
33 445936-16	1116/319	5	10-23-61 1221:52 PDT	No	AST-L	No BSP Kit.	Launch on first attempt. Liftoff and boost normal. S-01 hydraulic control malfunction caused a lofted trajectory and ultimately tumbling of the vehicle, precluding orbital injection.	

APPENDIX D LAUNCH DATA DIGEST (Continued)

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION & ORBITAL PARAMETERS
34 445936-17	1117/330	1	11-5-61 1200:32 PST	Yes	AST-L - No.	DRP Kit 18 added.	Launch on second attempt (first attempt aborted due to improper SLV-2 engine sequence). Liftoff, boost, separation and coast normal. S-01 thrust phase normal except for engine shutdown. Shutdown occurred from propellant exhaustion instead of command due to the cutoff command signal preceding arming of the circuitry. Excessive injection velocity resulting caused an overly eccentric orbit. No recovery attempted due to loss of attitude control (gas valve malfunction) during pass 8.	Azimuth: 17[illegible] deg Altitude: [illegible] nm Velocity: [illegible] fps Inclination: [illegible] deg Eccentricity: [illegible] Period: [illegible] min Perigee: [illegible] nm Apogee: [illegible] nm
35 445936-18	1118/326	4	11-15-61 1322:46 PST	Yes	AST-L - Yes. Aerial recovery.	Two radiometers added.	Launch on first attempt after 80 min of hold time, primarily for train schedules. Liftoff, boost, separation and coast normal. S-01 orbital injection velocity 113 fps low due to accelerometer-integrator error. Capsule air recovery effected on pass 18.	Azimuth: 171 deg Altitude: [illegible] nm Velocity: 25,[illegible] fps Inclination: 81.[illegible] deg Eccentricity: [illegible] Period: 89.[illegible] min Perigee: 13[illegible] nm Apogee: 1[illegible] nm
36 445936-19	1119/325	4	12-12-61 1240:22 PST	Yes	AST-L - Yes. Sea recovery on pass 64 (first 4-day recovery)	DRP Kit 58.	Launch on first attempt with 70 min of hold time for train schedules. Liftoff, boost, separation and coast normal. The S-01 engine exhibited higher than normal Isp and thrust. Intermittent fluctuation of hydraulic pressure noted during first 10 sec of S-01 burn.	Azimuth: 173 deg Altitude: 1[illegible] nm Velocity: 25,[illegible] fps Inclination: 81.[illegible] deg Eccentricity: .0[illegible] Period: 91.4 min Perigee: 1[illegible]0 nm Apogee: 257 nm
37 445936-20	1120/327	4	1-13-62 1341:08.50 PST	No.	AST-L - No recovery	Rocketdyne Block II engine thrust increased from 167,000 to 170,000 lbs by changing propellant mixture ratio. First operational use of a 10-sec delay in terminal count to ensure readiness of various range support functions.	Launch on first attempt after hold in phase IV of terminal count to replace shear pin in flowmeter drive shaft. Liftoff, boost, flight control, and ground guidance normal. Separation on schedule, but an electrical transient during process resulted in loss of link 2 telemetry power and a blown fuse in AC power bus to inertial reference package. S-01 ignition normal. No thrust vector control due to IRP power failure. One sec after S-01 thrust attainment, vehicle began to tumble and engine shutdown occurred 5 sec later. Velocity gain nil. Orbit not achieved.	
38 445936-23	1123/321	4	2-27-62 1139:20.50 PST	Yes.	AST-L - Yes. Aerial recovery on pass 65.	Power Supply Sub-system (SS/C) modified.	Successful liftoff achieved on first countdown. SLV-2 boost phase proceeded normally from liftoff through roll and pitch programs, and with correct ground guidance commands. Vehicle separation was normal. S-01 coast phase was stable and control gas consumption normal. S-01 propulsion exhibited normal start, thrust attainment, steady-state thrust characteristics, providing the desired impulse for attainment of a near-nominal orbit. Aerial recovery of the capsule successfully accomplished after 4 days in orbit (pass 65), the longest orbital period before capsule recovery yet achieved.	Azimuth: 177 deg Altitude: 129.[illegible] nm Velocity: 25,77[illegible] fps Inclination: 82.33 deg Eccentricity: 0.0[illegible] Period: 90.8[illegible] min Perigee: 1[illegible] nm Apogee: 251.[illegible] nm
39 445936-24	1124/331	5	4-17-62 1653:46.96 PST	Yes	AST-L - Yes.	DRP kit. First use of pure nitrogen mixture control gas.	Successful liftoff achieved on first countdown. SLV-2 boost phase satisfactory, including the first planned "dog leg" in the booster trajectory to achieve an orbit inclination angle of 74 deg. All S-01 sub-systems performed satisfactorily except for abnormally large amount of post-shutdown impulse resulting from delayed closure of main fuel valve. Aerial recovery of the capsule successfully accomplished on 33rd orbit.	Azimuth: 177 deg Altitude: 130.11 nm Velocity: 25,807 fps Inclination: 73.89 deg Eccentricity: 0.0077 Period: 90.73 min Perigee: 130.06 nm Apogee: 319.99 nm
40 445936-25	1125/333	4	4-28-62 1630:17.45 PST	Yes	AST-L - No. Recovery attempt unsuccessful on pass 46.	DRP kit. Second use of pure nitrogen as control gas.	Successful liftoff achieved on first countdown. SLV-2 liftoff and boost normal. PAM/FM channels of SLV-2 telemetry failed at liftoff. Second programmed "dog leg" and orbit inclination angle of 75 deg achieved. A second roll maneuver to compensate for roll induced by simultaneous pitch and yaw programs proved successful. Vehicle separation was normal. S-01 engine ignition was normal but a slight error in pitch attitude during the thrust interval resulted in higher than expected altitude and flight path angle. Orbital characteristics indicated all S-01 sub-systems were functioning properly.	Azimuth: 1[illegible] deg Altitude: 1[illegible] nm Velocity: 25,[illegible] fps Inclination: [illegible] deg Eccentricity: 0.0[illegible] Period: 91.17 min Perigee: 1[illegible] nm Apogee: [illegible] nm

APPENDIX D LAUNCH DATA DIGEST (Continued)

correct date to 5-15-62

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
41 445936-26	1126/334	5	5-29-62 1235:52.17 PDT 5-15-62	Yes	ART - Yes. Aerial recovery.	Similar to 1125.	Launch on first attempt. The countdown was delayed slightly in task 7 when difficulty was encountered in resetting the orbital timer. Four holds were also imposed for range clearance (trains), and 2 for abnormal 100 per cent LOX load indications caused by recycling of phase V. SLV-2 boost phase, separation, coast phase and orbital injection all satisfactorily accomplished. Control gas consumption appeared to be slightly above nominal but not excessive enough to endanger mission objectives. At time of telemetry signal loss, all vehicle sub-systems critical to the attainment of mission objectives were functioning properly. Successful capsule ejection and aerial recovery occurred on pass 63.	Azimuth: 172 deg Altitude: 184.8 nm Velocity: 25,697 fps Inclination: 82.35 deg Eccentricity: 0.0257 Period: 94.03 min Perigee: 184.7 nm Apogee: 402.8 nm
42 445936-28	1128/336	1	5-29-62 1700:44.03 PDT	Yes	ART-1 - Yes. Aerial recovery.	Similar to 1126.	Launch on second attempt. First countdown aborted due to S-01 horizon scanner malfunction. SLV-2 boost phase satisfactory except for pitch flight path deviation. MECO occurred due to propellant depletion resulting in deficient velocity and altitude at coast apogee. A greater than expected consumption of control gas was the result of an extraneous roll torque caused by exhaust stack misalignment. All S-01 sub-systems functioned properly. Successful capsule ejection and aerial recovery occurred on 49th orbit.	Azimuth: 172 deg Altitude: 120.1 nm Velocity: 25,679 fps Inclination: 74.16 deg Eccentricity: 0.0128 Period: 90.06 min Perigee: 225.7 nm Apogee: 178.0 nm
43 445936-27	1127/335	4	6-1-62 1731:27.75 PDT	Yes	ART - No.	Similar to 1128. DFR (direct-frequency-readout) instrumentation for turbo-pump added to booster.	Launch on first attempt. Relatively few technical difficulties and no holds during countdown. SLV-2 boost phase satisfactory; orbit attained appears to be nearest to nominal of any SLV-2/S-01 configuration launched to date. S-01 sub-systems performed satisfactorily to attain mission objectives. Extraneous roll torque, apparently related to exhaust stack misalignment, was again evident. Successful capsule ejection occurred on pass 65; however, recovery was not accomplished.	Azimuth: 172 deg Altitude: 132.3 nm Velocity: 25,715 fps Inclination: 74.26 deg Eccentricity: 0.0152 Period: 90.63 min Perigee: 132.43 nm Apogee: 257.95 nm
44 445936-29	1129/339	4	6-22-62 1730:46.80 PDT	Yes	ART - Yes. Aerial recovery.	None.	Launch on first attempt. Failure of liftoff signal resulted in umbilical ejection by lanyard action. MECO occurred slightly later than predicted. Excessive expenditure of control gas to maintain control during thrust interval attributed to turbine exhaust misalignment. All other systems performed satisfactorily Successful capsule ejection and aerial recovery on pass 50.	Azimuth: 172 deg Altitude: 130.49 nm Velocity: 25,637 fps Inclination: 75.1 deg Eccentricity: 0.00795 Period: 89.68 min Perigee: 130.59 nm Apogee: 195.54 nm
45 R030564-51	1151/340	1	6-27-62 1809:08.15 PDT	Yes	ART-1 - Yes. Aerial recovery on pass 43.	First S-01A. Modification included a horizon sensor; a velocity meter; pulse generating circuitry; on/off (nonproportional) control valves; dual-level pressure regulation system; a motor operated valve and orifices used for tank pressurization; primacord separation method.	Launch on first attempt. SLV-2 boost normal except MECO occurred from propellant depletion prior to transmission of guidance command. A slight deficiency in velocity was evident at coast apogee. Separation, coast, and orbital boost normal. Significant deviations from nominal trajectory conditions existed at orbital injection due to a velocity meter malfunction which permitted the S-01 engine to burn to propellant depletion.	Azimuth: 172 deg Altitude: 130.8 nm Velocity: 25,965 fps Inclination: 76.06 deg Eccentricity: 0.0368 Period: 93.68 min Perigee: 130 nm Apogee: 441.9 nm
46 445936-30	1130/342	5	7-20-62 1756:39.51 PDT	Yes	ART-1 - Yes. Aerial recovery.	None.	Launch on second attempt. First countdown scrubbed due to S-01 helium leak. SLV-2 boost phase adequate. MECO occurred from propellant depletion almost simultaneously with ground guidance command. All S-01 sub-systems performed satisfactorily after separation to attain mission objectives. Orbit attained appears to be most precise of any SLV-2/S-01 vehicle to date. Successful capsule ejection and aerial recovery on 33rd revolution.	Azimuth: 172 deg Altitude: 676,467 ft Velocity: 25,715 fps Inclination: 70 30 deg Eccentricity: 0.01405 Period: 90.431 min Perigee: 126.5 nm Apogee: 242.8 nm

APPENDIX D LAUNCH DATA DIGEST (Continued)

FLIGHT NUMBER AND LMSC REPORT NO.	VEHICLE SERIAL NO.	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
47 445936-31	1131/347	4	7-27-62 1730:09.95 PDT	Yes	AET-L - Yes. Aerial recovery	First flight of booster model DM-21D2-1P2R and telemetry kit.	Launch on first attempt. SLV-2 boost phase satisfactory except pitch program appeared slightly deficient in pitchover rates. MECO occurred normally, separation smooth, and coast and orbital boost phases adequate. All S-01 vehicle sub-systems functioned properly to attain mission objectives. Capsule ejection and aerial recovery on 64th revolution.	Azimuth: 172 deg Altitude: 475,000 ft Velocity: 25,674 fps Inclination: 71.09 deg Eccentricity: 0.00405 Period: 90.718 min Perigee: 177.8 nm Apogee: 241.3 nm
48 B030564-52	1152/346	1	8-1-62 1717:29.39 PDT	Yes	AET-L - Yes. Aerial recovery on 64th orbit.	Second S-01A configuration. Booster especially equipped to study 20-cps oscillations.	Launch successful on second attempt. Range priority forced cancellation of first countdown. Greater than expected thrust from SLV-2, resulting in slightly high pitch flight path angle. Control gas pressure transducer inoperative shortly after liftoff. Estimated above nominal consumption of control gas during S-01 thrust interval to counteract roll torque. Orbital performance reported as satisfactory.	Azimuth: 172 deg Altitude: 480,900 ft Velocity: 25,740 fps Inclination: 82.24 deg Eccentricity: 0.0163 Period: 90.78 min Perigee: 179.7 nm Apogee: 262.2 nm
49 B030564-53	1153/349	2	8-28-62 1800:34 PDT	Yes	AET-L - Yes. Aerial recovery	Similar to 1152.	Launch successful on second attempt. Failure of S-01 command antenna caused cancellation of first countdown. SLV-2 boost phase adequate and coast apogee conditions satisfied. Separation processes smooth followed by orbital injection. S-01 guidance errors resulted in errors in velocity, altitude, and elevation flight angle and the attainment of an orbit which differed considerably from the nominal. Orbital performance reported as satisfactory. Successful capsule ejection and aerial recovery occurred during 65th orbit.	Azimuth: 172 deg Altitude: 125.4 nm Velocity: 25,785 fps Inclination: 65.2 deg Eccentricity: 0.0169 Period: 90.32 min Perigee: 111.1 nm Apogee: 250.7 nm
50 445936-32	1132/348	5	9-1-62 1339:08.53 PDT	Yes	AET-L. No recovery.	None.	Liftoff on first countdown. SLV-2 boost and ascent normal. All S-01 systems operated to place vehicle in orbit. A 4-sec-[illegible] [illegible] in S-01 thrust interval, but vehicle performance not affected. All sub-systems functioning properly at time of VTS telemetry fade to permit attainment of mission objectives. Orbital performance reportedly satisfactory. Capsule re-entry on pass 63. Recovery not accomplished.	Azimuth: 172 deg Altitude: 188.6 nm Velocity: 25,709 fps Inclination: 82.83 deg Eccentricity: 0.0279 Period: 94.43 min Perigee: 186.6 nm Apogee: 424.5 nm
51 445936-33	1133/350	4	9-17-62 1446:18.07 PDT	Yes	AET-L - Yes. Surface recovery during 17th orbit.	None.	Launch on third attempt (first attempt cancelled due to S-01 integrator problem which precluded launching within time window; countdown scheduled for the following day cancelled before ignition due to payload problem; second countdown cancelled in task 10 due to failure of S-01 lifeboat system solenoid valve to actuate). Liftoff, boost, separation and coast normal. All vehicle sub-systems performed satisfactorily to provide adequate trajectory conditions for orbital injection. Orbital period attained approximately 2.2 min higher than nominal, indicative of an excess in injection velocity of approximately 220-fps and is attributed to an error in velocity measurement by accelerometer-integrator combination. At signal fade at VTS, all sub-systems were functioning properly to permit attainment of mission objectives.	Azimuth: 172 deg Altitude: 120.9 nm Velocity: 25,905 fps Inclination: 81.76 deg Eccentricity: 0.034 Period: 93.30 min Perigee: 129 nm Apogee: 416 nm
52 B030564-54	1154/351	2	9-29-62 1634:49.58 PDT	Yes	AET-L - Yes. Aerial recovery during 49th orbit (Lifeboat).	None.	Launch on second attempt (first countdown cancelled when SLV-2 forward umbilicals disengaged prematurely). Liftoff, boost, separation, and coast normal. All vehicle sub-systems performed satisfactorily to provide adequate trajectory conditions for orbital injection; however, injection errors resulted as follows: 40 fps excess in velocity; 6 nm low in altitude; -0.2 deg elevation flight path angle; 0.5 deg in azimuth flight path angle. Orbital performance reportedly satisfactory except H3/D horizon sensor failed subsequent to 20th revolution.	Azimuth: 172 deg Altitude: 125 nm Velocity: 25,720 fps Inclination: 65.44 deg Eccentricity: 0.0142 Period: 90.32 min Perigee: 121.4 nm Apogee: 239.4 nm

APPENDIX D LAUNCH DATA DIGEST (Continued)

FLIGHT NUMBER AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
53 445936-34	1134/352	4	10-9-62 1135:38.77 PDT	Yes	AST-1 - Yes. Aerial recovery during 65th orbit.	None.	Launched on first attempt. Ground guidance lost at T+69 sec. (No steering orders or discretes were transmitted.) SLV-2 airborne sub-systems performed satisfactorily. MECO occurred due to propellant depletion. Critical events signalled by airborne backups. No S-01 time-to-fire or velocity-to-be-gained adjustments. S-01 sub-systems functioned satisfactorily, but the specific impulse of the propulsion system was low. S-01 shutdown due to fuel depletion. Significant trajectory errors at orbital injection (due to earlier loss of ground guidance). Orbital performance was satisfactory. Successful recovery accomplished.	Azimuth: 172 deg Altitude: 167 nm Velocity: 25,625 fps Inclination: 81.79 deg Eccentricity: 0.0142 Period: 91.02 min Perigee: 123 nm Apogee: 243 nm
54 B030427-01	1401/353	2	10-26-62 0724:39.80 PDT	Yes	GRD P/L - Nonrecoverable.	Modified S-01A.	Launch on second attempt. First attempt aborted when payload telemetry system power supply failed. Liftoff tone not properly generated. S-01A umbilicals released by "fly-away." SLV-2 sub-systems performed satisfactorily. MECO occurred due to propellant depletion (planned). SLV-2 coast apogee conditions satisfactory. S-01A sub-systems functioned satisfactorily. S-01A engine shutdown from propellant depletion (also planned). Orbit attained satisfactory.	Azimuth: 172 deg Altitude: 113 nm Velocity: 28,998 fps Inclination: 71.33 deg Eccentricity: 0.2902 Period: 148 min Perigee: 110 nm Apogee: 3020 nm
55 445936-36	1136/356	4	11-5-62 1404:32.08 PST	Yes	AST-1 - Yes. Aerial recovery during 65th orbit.	None.	Launched on first attempt. Boost phase satisfactory. Propellant depletion shutdown. Separation smooth. Coast phase normal. S-01 main engine provided proper orbital injection conditions. Orbital performance satisfactory. Successful capsule ejection and recovery on 65th orbit.	Azimuth: 172 deg Altitude: 130.3 nm Velocity: 25,720 fps Inclination: 74.98 deg Eccentricity: 0.0156 Period: 90.74 min Perigee: 130.3 nm Apogee: 259.3 nm
56 445936-35	1135/347	4	11-24-62 1600:54.33 PST	Yes	AST-1 - Yes. Aerial recovery during 81st orbit.	None.	Launched on first attempt. Boost phase adequate. Separation and coast normal. S-01 engine provided impulse for proper injection conditions. Orbital performance satisfactory. Successful capsule ejection and recovery on 81st orbit - longest orbital time to date.	Altitude: 131.1 nm Velocity: 25,600 fps Inclination: 65.14 deg Eccentricity: 0.0100 Period: 89.90 min Perigee: 131.8 nm Apogee: 213.9 nm
57 B030544-55	1155/348	2	12-4-62 1130:35.6 PST	Yes	AST-1 - No. Unsuccessful recovery attempt on 32nd pass.	None.	Launched on first attempt. Liftoff and umbilical ejection normal. Booster telemetry failed at T+0.45 sec. Propellant depletion MECO before attainment of required velocity. Coast apogee velocity and altitude significantly different than nominal. Significant deviation in S-01A injection conditions and orbital parameters due to combination of SLV-2 velocity deficiency and S-01A attitude error. Orbital performance reportedly satisfactory. Low perigee orbit necessitated early recovery attempt. Successful capsule ejection and re-entry on 32nd pass. Damage during retrieval attempt resulted in loss of capsule.	Altitude: 119.6 nm Velocity: 25,630 fps Inclination: 65.16 deg Eccentricity: -0.0 Period: 88.98 min Perigee: 83 nm Apogee: 206 nm
58 B030544-56	1154/360	5	12-14-62 1326:07.00 PST	Yes	AST-1 - Yes. Aerial recovery during 65th orbit.	None.	Launched on first attempt. Boost phase adequate to satisfy coast apogee criteria. Separation and coast normal. S-01A engine provided impulse for near-nominal orbital injection. Flight path angle at injection slightly negative. Orbital performance reportedly satisfactory. Successful capsule ejection and aerial recovery on 65th orbit.	Altitude: 126.5 nm Velocity: 25,730 fps Inclination: 70.95 deg Eccentricity: 0.0151 Period: 90.53 min Perigee: 125 nm Apogee: 251 nm

APPENDIX D (Continued)

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
59 8030564-57	1157/369	1	1-7-63 1309:49.06 PST	Yes	AKT-L - Yes. Sea recovery during 65th orbit.	None	Launched on first attempt. Booster performance adequate to provide near-nominal coast apogee conditions. Separation and coast phase normal. S-01A engine provided impulse for near-nominal orbital injection. Flight path angle at injection slightly negative. S-01A orbital performance reportedly unsatisfactory due to horizon sensor malfunction prior to fifth orbit. Successful capsule ejection occurred on 65th orbit; however, re-entry occurred outside the planned area. The capsule was recovered from the water.	Altitude: 125 nm Velocity: 25,745 Inclination: 82.74 Eccentricity: 0.0167 Period: 90.61 Perigee: 120 nm Apogee: 259 nm
60 445936-59	1159/354	5	2-28-63 1348:30.22 PST	No	AKT - No recovery	Standard S-01A except for extension of forward rack to incorporate special payload. First SLV-2A booster.	Launched on second attempt. First attempt cancelled in task 12 because of difficulty with solid booster circuitry. One hold imposed (48 min) for S-01A oxidizer pump problem and range clearance. Solid booster No. 2 failed to ignite at liftoff and did not jettison. Data indicate solid motor No. 2 was not electrically connected to the booster and did not receive a firing signal. Loss of control occurred as a consequence of the failure of No. 2 to burn and resulted in flight termination and SLV-2A breakup at approximately T+127 sec. The S-01A vehicle apparently remained intact until T+219 sec.	
61 445936-64	1164/360	4	3-18-63 1313:00.90 PST	No	AKT (OFE) - No recovery	First vehicle to have airborne portion of BTL guidance system in S-01A vehicle. Second TAT (SLV-2A) booster.	Launched on first attempt. Forty-three min hold time. Liftoff normal. Booster objectives achieved. S-01A failed to attain orbit. Loss of pneumatic control shortly after separation due to an electrical malfunction (temporary short in safe/arm J-box). Lack of roll control during thrust interval prevented proper exercise of guidance. Premature shutdown of engine, which was indirectly associated with the electrical malfunction, precluded orbital attainment.	Altitude: 99.1 nm Velocity: 24,833 Orbit conditions were not attained.
62 445936-60	1160/376	5	4-1-63 1501:00.36 PST	Yes	AKT-L - Yes. Aerial recovery on 49th orbit.	None.	Launch on first attempt. No holds imposed. Ninety min delay time. Liftoff normal. SLV-2 performance excellent. Near-nominal coast apogee conditions. S-01A subsystems functioned satisfactorily. Near-nominal trajectory conditions for orbital injection provided. On-orbit problems reported were: loss of lifeboat control gas evidenced by exponential decay in sphere pressure; malfunction of single-phase 400-cps inverter evidenced by low output during later revolutions. Despite these problems, successful capsule ejection and aerial recovery were effected on 49th orbit.	Altitude: 127.4 nm Velocity: 25,734 Inclination: 75.36 Eccentricity: 0.0156 Period: 90.65 Perigee: 127.4 nm Apogee: 256 nm
63 B030427-11	1411/372	1	4-26-63 1212:57.07 PST	Yes	AKT-L - No recovery	None.	Launch on second attempt. First countdown cancelled because of inability to actuate S-01A lifeboat solenoid valve. Two holds imposed in final countdown for range clearance (28 min). SLV-2 boost phase satisfactory. Coast apogee target conditions satisfied. Sporadic SLV-2 yaw control during initial 40 sec of flight. Incorrect S-01A horizon sensor bias angle resulted in a +2.5 deg flight path angle and a >20 mile deviation in altitude at injection. Useful orbit not attained. Low perigee and positive flight path angle caused vehicle to re-enter during first revolution.	Altitude: 181.0 nm Velocity: 25,257 Inclination: -- Eccentricity: 0.043 Period: 90.82 Perigee: 25 nm Apogee: 330 nm

* No. Auth: History Report and Space Log

APPENDIX D (Continued)

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
64 445936-65	1165/364	5	5-18-63	Yes	Similar to 1164. Recovery on 33rd orbit.	None.	Launched on fourth attempt. Two countdowns on 7 May and 8 May cancelled because of excessive upper air winds; one on 17 May cancelled because of questionable integrity of S-01A primacord. Two holds in final countdown (23 min). Liftoff and boost phase normal. Nearly exact coast apogee conditions attained by SLV-2A. Guidance of the S-01A vehicle less accurate than predicted. Injection errors in altitude, flight path angle, and inertial velocity resulted in deviations from nominal orbit. After injection, removal of power to ground guidance beacon and application of power to payload (D-timer events) did not occur due to an apparent short. Attainment of orbital mission objectives were thus precluded. Vehicle recalled after 33 orbits.	Altitude: 75.25 n Velocity: 11,830 Inclination: 74.61 d Eccentricity: .02717 Period: 91.188 Perigee: 85.1 nm Apogee: 282.0 n
65 BO30564-61	1161/362	4	6-12-63 1658:38.03 PDT	Yes	GRD payload; recovery on 65th orbit	BTL missile-borne guidance system in S-01A vehicle.	Launched on second attempt. First countdown cancelled in terminal count because of difficulties with SLV-2A engine slew checks. No holds in final countdown. A large roll torque in SLV-2A within first second after liftoff. Departure azimuth in error by 5 deg. Trajectory such that it necessitated range safety to consider a destruct. Appropriate commands properly executed to correct error SLV-2A objectives subsequently achieved. S-01A subsystems functioned satisfactorily. Excessive amount of control gas consumed during thrust interval to overcome a roll torque. Orbital performance satisfactory. Aerial recovery on 65th orbit.	Altitude: 107.9 nm Velocity: 25,765 f Inclination: 81.83 de Eccentricity: 0.01851 Period: 90.79 mi Perigee: 106.6 nm Apogee: 240.3 nm
66 445936-66	1166/381	2	6-26-63 1737:26.16 PDT	Yes	Aerial recovery on 65th orbit	[redacted]	[redacted]	Altitude: 110.0 nm Velocity: 25,732 fp Inclination: 81.61 deg Eccentricity: 0.01538 Period: 90.596 mi Perigee: 110.45 nm Apogee: 221.44 nm
67 BO30427-12	1412/388	1	7-18-63 1700:10.58 PDT	Yes	ART-L - aerial recovery on 65th orbit.	Similar to 1411	Launch on second attempt. First attempt 17 July aborted - SLV-2 destruct receiver No. 2 abnormal. No holds in final countdown. Liftoff normal. Boost phase adequate. Abnormal control transients due to flight control problem during latter portion of boost. S-01A subsystems performed satisfactorily. An electrical short occurred at separation - no apparent affect except loss of link 2 T/M. Orbital performance reportedly satisfactory.	Altitude: 110.4 nm Velocity: 25,717 fp Inclination: 82.87 deg Eccentricity: 0.0144 Period: 90.44 min Perigee: 111.5 nm Apogee: 216 nm

APPENDIX D, LAUNCH DATA DIGEST (Continued)

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS
68 445936-67	1167/382	2	7-30-63 1700:26.63 PDT	Yes	ABT-L. Yes - Aerial recovery on 33rd pass.	Missile-borne portion of BTL guidance system installed in S-01A.	Launched on first attempt. No holds. Liftoff and umbilical ejection normal. MECO from propellant depletion. Slight velocity deficiency. Subsequent guidance commands and S-01A thrust compensated for the deficiency. Control gas consumption during thrust interval greater than expected - extraneous roll torque counteraction. Orbit obtained near nominal. Orbital performance of all subsystems reportedly satisfactory. Successful capsule ejection, re-entry, recovery on 33rd pass.	Altitude: [illegible] Velocity: [illegible] Inclination: [illegible] Eccentricity: [illegible] Period: [illegible] min Perigee: 91.0 n mi Apogee: [illegible]
69 B030564-62	1162/377	4	8-24-63 1729:58.13 PDT	Yes	ABT-L. Yes - Aerial recovery on 65th revolution.	Missile-borne portion of BTL ground guidance in S-01A vehicle.	Launch on second attempt. No holds. First attempt cancelled at T-2.6 sec - defective relay in DAC AGE engine ignition circuitry. Liftoff tone premature; otherwise liftoff normal. MECO from propellant depletion (planned). All ground guidance discretes properly transmitted and executed. Required coast apogee conditions provided by SLV-2A. Orbit obtained near nominal. Orbital performance of all subsystems reportedly satisfactory. Capsule ejection, re-entry and recovery on 65th revolution.	Altitude: 98.2 nm Velocity: 25,822 fps Inclination: 75.00 deg Eccentricity: 0.01[illegible] Period: 90.62 min Perigee: 97.84 nm Apogee: 210.35 nm
70 445936-69	1169/394	5	8-29-63 1331:03.97 PDT	Yes	ABT-L. Yes - recovery on 65th revolution.	None	Launch on first attempt. One hold imposed (32 min) because of intermittent operation of a pressure switch on launcher. Boost phase satisfactory, proper coast apogee conditions provided. Two S-01A anomalies evident during ascent - an excessive current transient at separation and a delayed engine shutdown. No damage from current transient; excess in injection velocity - gain from delayed shutdown. Orbital mission objectives satisfied.	Altitude: 161.4 nm Velocity: 25,177 fps Inclination: 81.47 deg Eccentricity: 0.[illegible] Period: 90.80 min Perigee: 161.8 nm Apogee: 180.2 nm
71 445936-63	1163/383	2	9-23-63 1600:00.20 PDT	Yes	ABT-L. Yes - on 49th revolution		Launch on first attempt; no holds imposed - no major difficulties encountered. Liftoff normal. Booster launch objectives satisfied. MECO by propellant depletion as planned; however, propellant utilization less than the ideal. S-01A subsystems performed satisfactorily to provide proper orbital injection conditions. Orbital performance reportedly satisfactory. Successful capsule ejection, re-entry and aerial recovery on 49th revolution.	Altitude: 98.85 nm Velocity: 25,817 fps Inclination: 74.977 deg Eccentricity: 0.01912 Period: 90.609 min Perigee: 99.2 nm Apogee: 237 nm
72 B030758	1601/386	4	10-29-63 1319:03.72 PST	Yes	ABT-L; yes - on fifth day	[redacted]	[redacted]	Altitude: 157.[illegible] nm Velocity: [illegible] fps Inclination: 89.915 deg Eccentricity: 0.00276 Period: 90.850 min Perigee: 155.6 nm Apogee: 191.6 nm

APPENDIX D, LAUNCH DATA DIGEST (Continued)

FLIGHT NO. AND LMSC REPORT NO.	VEHICLE SERIAL NUMBER	PAD NO.	LAUNCH DATE AND TIME	ORBITAL ACHIEVEMENT	CAPSULE TYPE AND RECOVERY	VEHICLE CHANGES INCORPORATED	FLIGHT DESCRIPTION	INJECTION AND ORBITAL PARAMETERS	
73 B030767	1171/400	2	11-9-63 1227:54.51 PST	No	AET-L; no	Booster non-TAT; standard SS-01A	Launched on first attempt. Two holds for trains - eight min. Boost phase unsatisfactory. Deterioration of flight control system at T+113 sec; complete loss of control at T+134 sec. Deterioration of flight control preceded by loss of main engine flame shield at liftoff. Exposure of control system wiring to excessive temperatures probably responsible for decay in control system performance. Separation due to structural failure. Both stages tumbled but remained basically intact. Evidence of damage in forward end of SLV-2 and payload separation from SS-01A. SS-01A subsystems normal until flight termination; remained in standby status after break-apart.		
74 B030780	1172/406	PALC 1 Pad 1	11-27-63 1315:40.13	Yes	AET-L; no	Similar to 1171	First launch of this configuration vehicle from PALC. Launch on first attempt. One hold for 12 min - range clearance. Error in countdown procedure resulted in omission of tank pressurization after SS-01A propellant loading. Boost phase satisfactory despite lower structural strength of SS-01A. Trajectory conditions near-nominal. Longer than predicted SS-01A engine burn duration because of low thrust. Mission objectives and near-nominal orbit attained. Link 1 telemetry not switched to orbital assignment after injection. Orbital performance reportedly satisfactory; however, attempted recovery on 81st pass unsuccessful.	Altitude: Velocity: Inclination: Eccentricity: Period: Perigee: Apogee:	99.6 nm 25,779 fps 69.95 deg 0.01577 90.17 min 98.1 nm 211.5 nm
75 B030797	1168/398	Pad 2	12-21-63 1345:41.7	Yes	AET-L; ~~no~~ Yes; Aut [redacted]	[redacted]	[redacted]	ltitude elocity nclination Eccentricity Period Perigee Apogee	99.7 25,758 fps 64.88 deg 0.01407 89.98 min 99.5 nm 200.6 nm
76 Vd2E 4-2-01 (AF Evaluation Office Report No.)	1174/389	4	2-15-64 1338:23.10 PST	Yes	Successful Air recovery	LV-2A/SS-01A; BTL Guidance in SS-01A	Launched on first attempt. One hold for trains. Liftoff normal. MECO from guidance command. Stage II separation was normal; however, due to a slow shutdown of the stage II engine, the injection velocity was slightly greater than required	Alt Vel Incl L Eccen Period Peri Apo	101.1 25,833 74.98 0.0203 90.86 101.09 248.39

Flt No.	Vehicle Serial Number	Pad No	Launch Date	Orbital Achievement	Vehicle Changes Incorporated	Flight Description
77	1175/396	PALC 1 Pad 1	3-24-64 1422:48.52 PST Capsule Type: AET-L No recovery	No	LV-2A/SS-01A BTL Guidance in SS-01A	First TAT vehicle from PALC; Launch or 1st attempt; 3 holds - 20 min total duration, for LV-2A gyro heater cycling. Reclycling BTL loop checks and for evaluation indicated SS-01 fuel leak; Boos performance sat factory; electr al power proble in SS-01A at VE resulted in complete loss o control during thrust interval; separation and ignitio normal; engine shutdown premature due to loss of contr which coupled with mis-direc tion of thrust, precluded orbit attainment.
78	1604/395	PALC 1 Pad 4	4-27-64 1623:43.55 PDT Capsule Type: No recovery	Yes	16th TAT (LV-2A)	Launched on firs attempt. Very accurate orbit was attained. SS-01A separatic an electrical overload of shor duration within the pyro distribution system, s part of the pyro bus power was permanently lost This precluded recovery, backup system, and research payload operations. The satellite was satisfactorily deactivated on orbit 7 and reactivated on pass 246. Power depletion occurred at Orbit 359.

Progran 162 Vehicles Launched:	78
Vehicles Orbited:	61
Capsules Recovered:*	40
Air	35
Sea:	5

* Four payloads, three of which orbited, were nonrecoverable types.